VOLUME V.

BRICKWORK, CONCRETE, FINANCIAL, FLUMES, LAND, PIPE SUBMERGED, RESERVOIR VALUES, TUNNELS

IN THE

District Court of the United States

FOR THE

Northern District of California

SECOND DIVISION

SPRING VALLEY WATER COMPANY, Plaintiff, vs. CITY AND COUNTY OF SAN FRANCISCO, ET AL., Defendants.	Nos. 14,735, 14,892, 15,131, 15,344, 15,569, Circuit Court of U. S., Ninth Judicial Circuit, Northern District of California, and 26 and 96 District Court of U. S. Northern District of California, Second Division.

ABSTRACT OF TESTIMONY TAKEN BEFORE HONORABLE H. M. WRIGHT, STANDING MASTER IN CHANCERY FOR THE DISTRICT COURT OF THE UNITED STATES IN AND FOR THE NORTHERN DISTRICT OF CALIFORNIA, SECOND DIVISION, IN THE PROCEEDING ENTITLED SPRING VALLEY WATER COMPANY vs. THE CITY AND COUNTY OF SAN FRANCISCO, ET AL., IN EQUITY NOS. AS ABOVE.

For Defendants:
PERCY V. LONG, ESQ.
ROBERT M. SEARLS, ESQ.

EDWARD J. MCCUTCHEN, ESQ.,
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Witness: J. B. LIPPINCOTT for Plaintiff.

(Certain corrections noted in the record.)

CROSS EXAMINATION BY MR. SEARLS. 5536

Mr. Lippincott: Referring to page 24 of my memoranda: The figure of $8.99 on the Roosevelt Dam is for direct charges on the dam alone. That figure I got from the supervising engineer who built 5537 the dam, and it is for the structures that were a part of the finished work on the dam itself; it does not include roads, telephone lines, camps, and things of that sort. On the last line of that same table,

under Crystal Springs, I give a unit cost of $8.36 per cubic yard. That figure should not have been used in that form, but it can stand, with the understanding that that includes a 40% addition for indirect costs or auxiliary expense. It will be seen from the details that I give of the cost of a cubic yard of masonry, on page 7, that the total direct cost was $5.97. The total cost, including indirect cost, was $8.36. So to make that figure really comparable with the figures I have endeavored to use for other structures, it really ought to be $5.97 instead of $8.36. The figure of $10.49 is the total estimate for the dam, divided by the number of cubic yards, exclusive of the executive overhead, which I did not add.

5538 Mr. Metcalf: I find in my notes that on a 1 to 2 mixture, 1 of cement to 2 of sand in the mortar, that from 2.9 to 3 barrels of cement are required per thousand of brick. This would be equivalent to a little over 1½ barrels of cement per cubic yard of brick work.

I find another reference to a large storage well, built by us in Concord for the storage of sewage. It was a 20 inch brick wall about 22 feet in height, and something like 60 feet in diameter. The well was 330 cubic yards of brick work, laid in a 1 to 2 mixture of mortar, with a thin layer of plaster on the outside, and plastered with a brush only on the inside, required 1.48 barrels of cement per cubic yard of brick work. I find in looking at the American Civil Engineers' Pocket-book, at 523, a statement that with reference to mortar, with a standard size of brick 8¼ x 4 x 2¼ inches, a cubic yard of masonry laid with ½ inch to ⅝ inch joints will require from 0.35 to 0.40 cubic yards of mortar, or 1,000 bricks will require 0.80 to 0.90 cubic yards. If the joints are ¼ inch to ⅛ inch, a cubic yard of masonry will require from 0.25 to 0.30 cubic yards of mortar, or 1,000 brick will require from 0.45 to 0.55 cubic yards. Assuming 0.30, that is .3 of a cubic yard of mortar per cubic yard of brick work, this is equal to 8.1 cubic feet of mortar per cubic yard of brick work, and on the basis of 1 to 3 mixture, this would correspond approximately to .71 of a barrel of cement to a cubic yard of brick work, and on a 1 to 2 mixture would correspond to about 1.1 barrel of cement per cubic yard of brick work. That is for the narrower joints referred to in the article as being from ¼ to ⅜ inches.

5539 Mr. Dillman: I think as a rule the eastern brick is smaller than our brick, and this is an illustration of the point that I made on the first day of my examination that all statistics are partial, and by selecting your statistics you can prove anything you want to prove. The practice on this coast is not to use a 1 to 2 mixture for your plaster, but it is 1 to 3, or considerably leaner. By assuming a rich mixture and large joints, you can put any amount of cement into this brick masonry, but I have not done it, and I do not think it is done on this coast, nor was it done on this work. I do not think it is right to load it up with that amount of expense. It is good brick masonry,

and I am not prepared to say that the full estimate of Mr. Lippincott's is at all wrong. I am not taking issue with the statement, but I am stating it is not common practice.

Mr. Hazen: I think we agree on that.

Mr. Dillman: A 1 to 2 mixture would not add anything to the strength of the structure so far as the purposes for which it is intended is concerned. It makes the tensile strength of the mortar 5540
greater, but that is not important in this case, and does not add anything to the value of the structure, but it would add something to the cost of it.

Mr. Hazen: I should think that it added to the water-tightness of the work, and to its value; it is exceedingly good brick work, and to measure it by brick work laid by what we would call common practice, would not be fair.

Mr. Dillman: I considered ordinary brick work, and added something for the exceptionally good work here, which exists, but as a test of the value of this brick work and the probable cost of putting it in, I consider it as Mr. Hazen has, to a certain extent, in comparing it with the cost of concrete, and while I have estimated the brick structure, I really think that in the renewal of the plant, or rebuilding it, you would probably use concrete in these places where brick has been used. To make it water tight, I would not increase the percentage of cement. 5541
I would use fine clay, or a high grade of lime, or something of that sort to make it tight, rather than increasing the amount of cement. It would be cheaper, and you would reach the result more directly and better.

CROSS EXAMINATION BY MR. SEARLS.

I assumed that the cost of sinking the shaft would be $100 a foot vertically, and on the theory that there are 7.4 cubic yards to the foot in that shaft, that made $13.50 per cubic yard. The material is, I think, very likely a trap in which this is being sunk. The quarry material that I examined more carefully I thought was a trap, or metormophosed sandstone. The materials at the dam I did not examine so carefully, but it is a fairly hard rock that has been changed by heat or diffused by heat. Metormophosed sandstone can be very hard rock. I do not know that I classified the rock there mentally as 5542
very hard or very soft. It is not a very soft rock, or even a soft rock. It is a rock that I should think was in itself a fairly hard rock that is broken into many seams and crevices. I should think it would be a fairly hard rock to excavate in. I would say that this was a moderately hard rock, and moderately hard of excavation.

The only shaft that I have had to do with in sinking in a granite or hard rock was at the north portal of the Elizabeth Tunnel. That was sunk in a granite, and the direct cost per foot was $63.20, and the indirect costs on the north end of the tunnel were 25%, making

$15.80, or a total of $79 per vertical foot of sinking. We had some
5543 difficulty with water there, but not much. We had one sinking pump that kept the shaft clear. We had a cave in the driving of the main tunnel, and encountered sand and water, and this cave went clear to the surface of the ground, and we were unable to get through it, so we went ahead perhaps 1,000 feet, and sunk this shaft down to line, and then came backwards with our tunnel, and got under the cave and got by. The quicksand and the water that we had the trouble with was in the main tunnel. As to the daily progress, I have a note, north shaft 197 feet, 5 x 9, net 4 ft. 6 by 7 by 10; that is inside the timbers. Labor $8,345.08; material $3468.50; freight $629.62; total $12,443.20, or $63.20 per vertical foot. The above includes salvage loss on shipment, but not loss on building, which is loss charged to expense of building. The shaft was, I should think, possibly ¾ of a mile or a mile from the headquarters camp, and it was necessary to walk to the shaft from the camp. That was the division camp. That
5544 was my only experience in sinking shafts in hard rock, but I have had something to do with putting down shafts for wells in soft material.

The men that we had in charge of that work were gold miners. The engineer in charge put it down with a mining engineer. When you have a detached piece of work of this kind, where the amount to be done is small, the unit costs are higher than if you were doing a great deal of it. If you had a large mine with numerous shafts that have gone down to very considerable depths, the unit costs of sinking would probably be less than I have used. If you have to fix up an equipment to go down a short distance, the cost of obtaining that equipment distributed over a short depth of excavation makes a high rate.

Referring to indirect costs on the Gibralter Dam, auxiliary costs $101,110; that occurs in this way. The City of Santa Barbara requested the appointment of a board of engineers to make an estimate
5545 on the cost of building the Gilralter Dam, and that board that was selected consisted of Mr. William Mulholland, Mr. J. H. Quinton, and me, although I did not try to do much more than furnish data for the purpose of making the estimate. This estimate was presented to the city, and was used as a basis for an election which they had on a bond question, and is simply put in here as an illustration of the fact that others than myself make liberal estimates on these direct costs. I have used this sheet as an illustration, and I have given you all the information I personally used in preparing this estimate, and this was a part of it. It is my opinion, from the construction costs that were encountered in connection with putting in the base of that dam that these indirect costs that were estimated upon in January, 1914, were not high enough. On page 10 there is given the actual indirect costs that were encountered in connection with the putting in of foundations, and the first ten or fifteen feet of the structure, and that is a

better answer than I could give by simply trying to amend these figures on page 22. Those costs on page 10 are the costs that relate to the portion of the dam that has been built, and I think they are abnor- 5546
mally high. I think that the indirect costs due to the starting of the work, and putting in foundations, are higher than the average indirect costs would be. We had some flood losses that might possibly be considered as a portion of the contingency items mentioned on page 22. I would add flood losses to that figure. It would be the general percentage to cover incidentals or auxiliary expense. That I think probably should be increased from the figures shown on page 22. I do not think that I would personally make an estimate in just that form in which it is given on page 22. I do not believe that you can accurately 5547
distribute those costs under definite or specific heads. It is thrown together as one charge under general head.

I know that very considerable work was done on a road, and it was somewhat similar to the situation that we were talking about for the Crystal Springs Dam. There was a road in there, and when we began hauling heavy material over it, the road went to pieces, and we had to do considerable work in the way of repairing it. For some reason that does not appear in these indirect costs; probably it has been charged to some other account altogether. This tunnel runs under the Santa Ynez Mountains; it is about 4 miles in length, and at the end of the tunnel the dam is to be built. The road was constructed primarily for the purpose of building that tunnel, and when we began hauling cement, we found that our curves were too short, and we improved the alignment of the road by easing up the sharpness of the curves, and also by putting gravel on the road to improve its 5548
surface. Compared to the hauling that I have in mind in this 25 cent a ton mile rate, which was the hauling with teams, I guess the Half Moon Bay road running out from San Mateo is a good road for large motor trucks, and up to a point a comparatively short distance from the dam, you have an asphalt surface on a concrete base. I do not know what the road was before the asphalt road was there, but I imagine it was a macadamized road. I think you would find that there would be quite a number of roads to build around the dam; as the dam goes up you would want to haul around the two ends of it probably, and have roads to the rock crusher, and to the concrete 5549
mixers, and to the camp. Those roads may be temporary construction, but we have found that they piled up quite a big item in the end, and it took just as good money for that class of work as it did for the concrete that went into the dam.

I think you would find that there would be certain roads in the Crystal Springs Reservoir site that would have to be moved on account of the building of the dam, and the raising of your water levels. There would be a multitude of things that would have to be done around that dam, either directly or indirectly, on account of that

construction, and that would be substantial. I imagine that before that dam was built that there probably was a road up that canyon into the valley in which the reservoir is situated, and that when you blocked the way with a dam, there probably had to be a mile, or possibly more, of road built around the side. Now, a mile of road that goes
5550 around the side there might cost $5,000 or $6,000. If you have allowed for that in the inventory, it should not be included in my indirect costs.

Mr. Searls: The inventory does include the item of all those main roads.

In all probability these roads would be of a rough construction and a temporary nature, and I do not say that they would cost $21,000 or any other particular sum, but I do say that there are 40% of incidental expenses that come into a piece of work like that that have got to be paid for, and they are just as much an expense in connection with the construction of a great piece of work as if it was money that was going into the structure itself. It has been my experience that unless you allow for things of that kind in your estimate, your estimates are going to be too low, and you and your clients are going to suffer. In stating my experience, I base it on certain specific jobs which I have mentioned here, and in each of these jobs there is a certain percentage which can be computed for the various items of
5551 incidental expenses. My total of 40% is a general statement of what I think might happen.

The aqueduct was divided into a number of divisions. These divisions varied greatly in character. Division 2 was out on a plain where a canal was constructed in earth by means of floating dredges. There was no rock work. It was simply a question of excavating earth, and on that particular division this auxiliary expense amounted to 47.3%. Our next division, on which the work was done by steam shovels, in which there was some rock excavation, and a good deal of sidehill work, and where the conduit was lined with concrete; there was no close similarity between those divisions, but we had an auxiliary expense on that division of 24.4%. Division 3A, the Haiwee Reservoir division, involving the building of two earthen dams in which steam shovels were used, and hydraulic work, this auxiliary expense was 33.9% with work which was again wholly different, and in which
5552 there would be practically no possibility of comparing what these different items of auxiliary expense might be. Division 5A was practically all in tunnels and steel pipes, and a totally different character of work, and in that division we have an auxiliary expense of 37½%. The division that is next to the City of Los Angeles, and where the rock was soft rock, and where conditions again are different, and where we had a dam to build, we had an auxiliary expense of 22.8%. The average of all that is the percentage of 33%, including the executive. My purpose in stating this is simply to show that no matter what

kind of work we were doing, or wherever it was, far or near, we always had this auxiliary expense following us that we had to pay for, and it was my job to keep track of the expenditure of money as we went along with this work. We thought right down to the end that we were going to close out our work with a surplus of $1,000,000 or $2,000,000, and when it came to laying the last yard of concrete, and closing the work up, we just came through without enough money left to publish a final report on what we had done, and the thing that did that was the fact that we were all the time paying for these unexpected things that cannot be foreseen.

The estimate for equipment on that Gibralter job was $50,000. 5553
For Crystal Springs I should think there would have to be a considerable outlay for wagons, harness and live stock, if the hauling was to be done by animals, or for automobile trucks if it was to be done by automobile trucks. These items are taken care of in that 40%. The 25 cents a ton mile is what I thought was a fair price for going charges on the hauling of that material over roads of that character. I would expect to carry in this 40% account the wear and tear on the wagons and the live stock, or on the automobile trucks, and take care of that loss in value in that way. I have never contracted any hauling, 5554
but I have done a great deal of it. It is possible you could contract that hauling for 25 cents per ton mile. We contracted the hauling of our cement to the Gibralter Dam, and the price was 50 cents a ton mile, and the contractor was taking care of those losses that you speak of. On the aqueduct, on roads that were somewhat similar to the ones here, we were never able to get contract bids for anything like 25 cents a ton mile. We got bids of 25 cents a ton mile for hauling freight on flat desert roads, and that was the best figure that we got for that kind of hauling, until we bought 800 mules, and a complete equipment of wagons.

The road from San Mateo out to Crystal Springs is a fair road, but
it has curves in it, and a rise in elevation of 300 or 400 feet to get to 5555
the top of the dam.

Mr. Hazen: The height of the dam is 280 feet from sea level, and San Mateo is pretty near sea level.

Mr. Lippincott: The Crystal Springs road is a good deal better
road than we have to the Gibralter Dam. About half the distance in 5556
the haul from the depot to the tunnel at Santa Barbara is pretty much the same. From the Old Mission up, it is a road that is steeper and not so well surfaced.

When we did our hauling on the aqueduct, we had to feed the teams. I would not think there would be much difference in the cost of feed in San Mateo County and what we had to pay on the desert. We built a railroad, or had one built from Mojave, and most of our division camps were on that railroad. That road was built on a contracted freight rate with the Southern Pacific Co., and the price of

hay and grain was determined delivered at the different division points, and charged out to the different division men at the cost delivered by the store department. We used to figure that the feeding
5557 of the animals would cost about 75 cents a day to the animal. I do not imagine that the difference in the feeding of live stock would be much different at Mojave over what it would be at San Mateo. That is not a hay and grain country around San Mateo. I should think that your hay and grain would come from the San Joaquin Valley, or from around Salinas, and that is as long a haul as we would have to get it to Mojave. I do not think you could get it at a lower rate in San Mateo, but on the contrary; when we started to build the aqueduct, I came to it from the Reclamation Service, and on the Reclamation Service we had special freight rates. These freight rates were on local freight which was described as of freight moving between El Paso, Ogden and Portland to points on the aqueduct. We were given one-half class rate, and the freight rate that we had on the aqueduct was a lower rate than a private concern would be permitted to have under the law.

5558 In the matter of equipment, there would be such equipment as would be used around the dam itself for the mixing and placing of concrete, and there would a multitude of small tools. There would be the towers and hoists and tramways, and the crushing plant at your rock quarry, and your screens, and all that sort of thing. I think, on a job of that kind that your mixers and crushers would be pretty well used up before your job was over.

In my $1 a yard for mixing, I have excluded from that item all the interest and depreciation on the mixing machine, and that represents labor cost. I also have forms in that figure of mine. I would expect my mixers to be gone and off the job 2 or 3 times over. As to the
5559 tramway, you would probably get something out of your rails; your ties you would throw away, and your cars would be practically gone.

I don't believe you could say that a great deal of our equipment on the aqueduct was situated so far from transportation facilities that it did not pay for knocking down and bringing in. We had about 14 or 15 steam shovels, which were very bulky, but valuable pieces of machinery, all of which have been sold or have been transferred to other departments of the City. We got almost as much for the air compressors as we paid for them, and our equipment charges have been credited with all these sales. The million and a half for equipment is a net price. We started our aqueduct work during a period of de-
5560 pression, and we were unusually fortunate in being able to buy materials and equipment cheaply, and have pretty much our choice in the selection of men to put on the work. The equipment on the aqueduct was largely purchased in 1907. The Rand Air Compressors, with a capacity of 500 cubic feet of free air per minute, were purchased for $1600 apiece. When we were through using them after 3 or 4 years

of service, it is my recollection that we got just about as much for them as we paid for them. We bought 300 young mules, and used them through a term of, say, 3 years, and allowing for some lost by death, when we sold them we sold for as much as we gave for them. The purchase of that live stock was a very fortunate venture.

On page 23 of my memorandum it says "Indirect and overhead 5561
charges on concrete mixing and placing a larger power dam; general plant $2.18 per cubic yard." On the basis of 160,157 yards of concrete in place in the Crystal Springs Dam, you would have considerably over $180,000 for equipment. I would imagine that the $2.18 would include under the term of general plant not only all the mixing and placing equipment, but would also include a small branch railroad that ran in to the power dam; also all the camp buildings and the structures generally that were used, as well as the tools.

I don't know but what it might be an economical thing to build 5562
a railroad up there to the Crystal Springs Dam to handle the transportation problem, but I have not assumed that they would build one. I think that if you do not pay for these indirect charges in one way, you pay for them in another; if you don't put the money into a railroad, you have to pay 25 cents a ton mile for hauling, and pay equipment charges on mules and wagons. You asked me whether you are
to take the percentage at the power dam, when 40% of it was for a 5563
railroad. Well, as far as that being used as a guide, it might modify the figure of 40% which I have used for the Crystal Springs Dam, but if a substantial amount of money had been spent for a railroad at the Crystal Springs Dam, there might have been obtained a reduction in the cost. There would have been a reduction in the cost of hauling, and some reduction in other expenses of construction, so I doubt whether you would arrive at a final figure that would be materially different. That would mean that you would cut down your ton mile cost of hauling, and if you built a railroad you would increase your indirect cost and reduce your direct cost.

Taking the question in a broad way, it is my judgment from past 5564
experience that these auxiliary or incidental expenses come into this work in one form or another, and that you have them to pay. As an illustration, I cite an aqueduct that is 200 miles in length, in which there were many classes of construction, and in divisions both remote and close to city and railroads, and this same overhead charge carried right through in all those different localities. I believe it would occur in this particular job. It is to the best of my knowledge and belief that that 40% would be there—based on the matter of my personal judgment. I do not think that the power dam should be ignored. I compare the indirect costs on the power dam with the in-
direct costs which I use on the Crystal Springs Dam, just as an aid 5565
in the general formation of a judgment relative to matters of that kind. It is simply one of a number of instances where these costs

have occurred, and where they always occur; it has been the basis among many other things in forming my judgment to that effect. It is my judgment that in engineering matters you make a number of computations from a number of different viewpoints, and you arrive at a series of independent figures and conclusions; then, when you have all these different elements before you and review them, you form a judgment that is a personal judgment, and that is the thing you ought to use. That personal judgment is the result of all these separate instances.

5566 I have found that all these different viewpoints, all these different angles, from which you can discuss a problem of this kind, are beneficial, and are an aid, even if they are not in absolute parallel, and that the final judgment that is formed is a composite matter, based partly, and perhaps imperceptibly on all the different elements that go into the consideration.

The items in the Gibralter Dam for track and track maintenance, which aggregate 1.85% of the total cost, is for the track through the Mission Tunnel, over which we hauled the cement for the contractor, and charged him what we thought would be a fair operative price. At Crystal Springs you would have a tramway approximately a mile long from the quarry down to the dam, instead of a tramway 4 miles long. I would consider the tramway as a part of the equipment charge
5567 at the Crystal Springs Dam. I think that tramway would be a portion of the equipment that would go into Crystal Springs indirect costs. In the case of the Gibralter dam, in the actual overhead—I think that was considered a part of the indirect, tracks and trestles $1908 was the actual cost for about ¼ of the work. We actually spent in repairing the track in the tunnel on that Gibralter work $9,827. Instead of using all of that figure as an indirect cost, I divided it by 4—arbitrarily—and used the figure $2,456, because the tramway is in fair shape, and ready to proceed with the remaining portion of the work. In the estimate given on page 22 there is an item of $5,000 for track; that is purely an estimate and an arbitrary figure.

Referring to page 22, my contingencies item amounts to 11.78% on
5568 the direct construction cost, and I suppose that was 10% of a sum of a number of items for direct and indirect costs. I do not think that is a large item. If I applied that to Crystal Springs I would have $138,000, which would be quite a large item, but I would say that that would be an amount which would be likely to be met in such a job in some form or other.

I am not particularly familiar with the history of the Crystal Springs Dam construction, but I have looked at photographs of the work while it was in progress, and if the work was done in that way today, I think these figures would be inadequate. I do not think it would be done that way today. There have been improvements in the methods of work since then. The engineer in charge was un-

doubtedly impressed with his responsibility. I know, from personal 5569
experience, that there were suits brought in which the question of the menace of that reservoir and dam was discussed. Colonel Mendell, who was in charge of the Army Engineers office in San Francisco for years, told me that he testified that we would not live under the Crystal Springs Dam, because he had certain apprehensions about it. I presume that Mr. Schussler was impressed with the gravity of that situation, and did use every possible effort to make that structure stable. I would not build a dam on which half a million people were depending for water in anything but the most stable and orthodox manner, but there are cases where the uses of the water would not be so important where I would be willing to recommend dams of a good deal less substantial construction, and I have done that as a matter of practice. I think you had to have a good dam there, and I consider that the Crystal Springs Dam, as I have described its reconstruction by my methods, would be absolutely safe so far as preserving the water supply of San Francisco, and the safety of the inhabitants of San Mateo are concerned.

I have not included the items appearing on page 2 of this report, 5570
under the heading "Washington office expense, expert engineering, Chicago office expense, Supervising Engineer's office" in my indirect expenses, as shown on page 20 of my memorandum. I would expect that the item of the office in Washington, Chicago, and the Supervising Engineer, would be contained in the 13% as shown on page 23 of the summary of indirect and other expenses. The items are arranged in this way: The total indirect expenses, including executive, are shown on page 20. These total indirect, including general executive or overhead are deducted from the total cost of the structure, and a ratio of total indirect to direct of 57% is obtained; from this 57% the $270,069, and also $71,418, amounting to 13.1% of the construction cost, are deducted from the 57%, leaving 44.3% for the auxiliary or indirect expenses; so that it is there taken
out. The 13.1% has nothing to do with auxiliary charges. The item 5571
on page 20 for telephone system, $8,369, probably included the telephone from the nearest town to the dam. The item $52,830 of wagon-load construction included the building of a wagon road up the canyon to the dam, and the item of railroad construction, $365,769, was for a railroad built up there solely for the purpose of building the structure.

Referring to the large government dam, page 20, my first item, 5572
testing dam site, $63,000, makes 3% of my total direct cost, which if applied to Crystal Springs would give a cost of $35,000 for testing the dam site alone. That charge is for exploration on the bed-rock in various ways, and determining the adequacy of the foundations and abutments. I do not consider that an unreasonable charge.
It is done before the stripping of the dam is undertaken. I would 5573

think that $35,340 was a pretty high figure for the exploration. It might possibly be between $15,000 and $20,000 quite readily. That all depends upon circumstances. If the bed-rock shows quite uniform when you put down say 20 holes, and it looks as if there is a smooth condition, then a few holes would be sufficient, but if there are eccentric and eratic results from the explorations you would want to put down a great many more. I have in mind the Wachussetts Dam for the Boston Waterworks. There was actually an overhanging bench of bed-rock in the foundation of that dam that made the explorations very eratic in their indications, and called for a very elaborate set of explorations. I am familiar with the formation of Crystal Springs in a general way, but you could not tell from the character of the rocks whether that presents great difficulty in exploration. If you take the lower Otay Dam, in San Diego County, it had just one fissure, perhaps not over 10 feet wide, that went down I think over 100 feet beneath the bed of the stream; it all had to be explored, as there was nothing in the abutments that would indicate that.

5574 Referring to telephone lines, $8,369, which represents four-tenths of a percent of the total direct charge on the government dam, and which, if applied to the Crystal Springs Dam would mean $4,612 as the cost of the local telephone system; in addition to the installation of the telephones, you would have to maintain them, operate them, and have a central station, and all that sort of thing. It is the up-keep and operation of it, and that is charged in on the indirect cost.

Referring to wagon road construction as applied on the basis of the government dam, which would mean $29,450 on the Crystal Springs Dam; those costs are not only for the purpose of building the road, but keeping it in condition of repair and operation during the construction of the work. I do not know whether this item of
5575 $29,450, if applied on the same basis as it was applied on the government dam, would include a very heavy maintenance charge or not; it impresses me that here was a situation where they had a railroad, and still spent this amount of money for a wagon road. You have to have wagon roads whether you have railorads or not. I assumed that we would build the Crystal Springs Dam by steam haul, and that what constitutes the railroad charges in the other dams would have to be applied here as a part of the maintenance of the roads, and the interest on equipment, and the depreciation on equipment, and to the additional increased cost per yard of concrete. That is, if you do not have the rail transportation, your cost on the concrete in place goes up. If you had your railroad there, you could probably use something like 5 cents a ton mile for transportation charge, whereas, if you had to haul it on a wagon road, you use 25 cents. If we take these ratios from these other structures,

and assuming that your percentages are correct, we would have 5576
about ⅛th of my entire construction charge, consisting of the indirect charges to transportation. That would be a large item if figured that way, but I am not saying that there is as much as 17% overhead due to transportation. I am simply saying that those incidentals or indirect expenses come in, and they have got to be paid, and there are many of them.

I do not believe I can tell you what part of my 40% would be a reasonable figure to spend on roads. I should think it would be
quite a reasonable thing to spend $8,000 on the construction, main- 5577
tenance and operation of roads for that dam. The additional charge due to the wear and tear on wagons and live stock I do not believe I could estimate offhand, but I do not think it would amount to $200,000. I am not taking into consideration the tramway for the stone from the quarry. I allowed 10 cents a ton mile haul, and considered the tramway a portion of the equipment charge for the dam. The equipment charge on the tram road would be in addition to the 10 cents. Considering the depreciation and interest on the tram road equipment, I do not think I would get up to $200,000 on just those charges. I do not believe that I could figure what the charge on the maintenance of my transportation equipment would be offhand.

Power plant; that charge might go in in a number of different 5578
ways. It might go in in the rates at which power was sold, and it might also go in as a cost of installing the plant. You might be two or three years in building Crystal Springs Dam, and if you could buy your power for a reasonable figure, say something like a cent for a kilowatt hour, you probably would not build a power plant. I think possibly you might get in for that. The amount that you will have to pay for power is something like the cement proposition,
it is very largely fixed by what it will cost you to produce your 5579
own power. When we purchased power for the aqueduct construction, the way we went about getting a rate was to design a complete power plant, and we figured out what we could produce power for. Then we took those figures and went to the power companies, and asked them to make us a rate. The only discussion we had with them was whether our figures as to the cost of our power plant and its operation were correct. When we came to an agreement on what we could afford to make power for, they sold us power at that figure. This amount I have here would be one that would provide for the installation of a high duty power plant of your own. The plant could be installed for possibly half of that amount.

The presumption is I should think that if the cost of the plant 5580
is to be based on the theory of reproduction, that all this reconstruction would be going on pretty much at the same time, and there would be a demand for power, not only at the dam, but else-

where at the same time. The proportionate charges would be very much less if you had all these places to use the product of one power plant, except that you have to have a bigger installation. I do not know that proportionately the charge would be less. When you get your steam engine up to a certain capacity, then the proposition probably would be to put in another unit instead of getting a bigger and bigger installation.

5581 The thing is that those expenses are going to be there in a great big block; there are many items that I have not listed in the other cases that would come up in this case. I can't say just what they are. If you go to the Calaveras Dam today you will find them building a great temporary structure to carry the flood waters by the dam. That will all be torn out next season after the flood season has passed, and if you should go back there in 3 or 4 years from now, there would not be an indication of its being there. You will have something like that to do in the Crystal Springs Dam, and it is simply
5582 the expenses that are coincident to the construction of any great work of this kind that are very substantial and have got to be paid. You would have to provide for the possible flood danger from that drainage basin when you uncovered those foundations.

Questioned by Master.

If I were to sit down here now and take a week in making an analysis as to the 40% indirect charge, I could not do it. I do not think I could imagine all the things that are going to happen here, and I do not think it is necessary to try.

CROSS EXAMINATION BY MR. SEARLS.

5583 I think if you will observe the table on page 23 you can see that the percentages which I find on one job are an indication as to what the percentages would be on another job, but to say that the analysis of the various items which you might pick out of one structure should apply in the same ratio of percentage to the same item in another structure, I think would be erroneous. I do not see anything in this table to cover small tools, and that certainly is a very substantial item. I don't see anything in this list to cover losses by fire, or anything to indicate injuries to employees.

Questioned by Mr. Dillman.

There may be a general statement with reference to the dam in regards to a loss by fire in that list, but I think it was put in in the general executive; there was a charge that was surprisingly small.

Mr. Metcalf: The casualty insurance to be carried on Crystal
5584 Springs construction is usually not included in overhead, because that is carried into the contract figure. We draw a specification that the contractor shall indemnify you, so therefore it becomes a part of the contractor's figure. Fire insurance is the same thing. In our pump stations, and structures of that sort, we do not usually carry

fire insurance; on the temporary buildings the contractor has to carry it.

Mr. Lippincott: I am under the impression that we put it in among the auxiliary expenses on the aqueduct distribution of accounts. Concrete replacements were charged in as auxiliary expense. I do not see the injuries distributed as such in this statement. If I were building the dam by day labor, I would expect to put it in as an auxiliary expense; if the work were done by contract, the contractor would have to take care of that, and that is the way it is handled in the Santa Barbara account. I think that would go
in as an auxiliary expense, and that was the way it was carried on 5585
the Gibralter Dam.

The rail transportation on the Gibralter Dam referred to the transportation of laborers, and also to sundry freight charges, not including the charges on cement. It is possible that small tools might be in the item "Plant installation", but I would hardly ex-
pect them to be. I think those small tools probably were charged 5586
out by the Government, but just how they may have entered into the construction account is not clear to me from the account.

Questioned by Master.

It reads this way "small tools, drill steel, etc."—and then a line drawn, and then it says "tools in use on work, but not carried on inventory, $2358.39". That would look as if it were the value of the small tools on that date, but it is handled in the plant account.

CROSS EXAMINATION BY MR. SEARLS.

There might have been an expenditure for some tools that would 5587
aggregate a great deal more than that. We used to use in making up our estimates $1 a foot on the covered conduit in the desert for tools and equipment, and $2 a foot for tools and equipments on tunnel work in making the preliminary estimate. Tools might be different on the dam construction, where the work was largely handled by machinery, as there would be a heavier charge for plant, and possibly a smaller charge for small tools. It is not my experience that carpenters used their own tools on our work. Referring to page 20, I do not see anything in there for failures or replacements or the removing of poor concrete. It is possible that you might have a poor lot of cement delivered to you that would cause removals or replacements, and I do not see any provision for that. We had very
much less trouble with our blended cements than we did with our 5588
straight cements; we never had any failures with Tufa cement. I think we have a charge here in the aggregate of something like $70,000 for replacement, and that is a very small item in a $25,000,000 charge. There is a statement here about replacements reading "Concrete replacements $72,752". Those were in all the different classes of construction we had. We put a rip-rap face on

the South Haiwee Dam, and we had to remove it and put a concrete face on it, because the action of the waves and of the soil was such that the voids were sucked out through the rip-rap, and the dam showed washing, and that had to be taken care of and replaced with a concrete base. This dam was an earth dam. We only had
5589 earthen dams on the aqueduct. At the Laguna Dam we had several occasions where the cement was bad and was rejected, but that was before it got into the dam. I do not recall any replacements in the concrete structures themselves.

Mr. Hazen: In the Ashokan Dam of the New York City supply, there is a large amount of inferior concrete work that seemed to be perfect work when it was put in, but in the two years since it has been placed it has disintegrated and gone to pieces very badly, and is in course of being replaced now. That apparently came from cement made by an abbreviated process that met all the standard specifications, and yet was not durable. Cement specialists are working on it at the present time. My advice was asked in regard to this particulay concrete, and I went over it and had a conference with the cement men immediately before I came out here in Sep-
5590 tember. I know of a number of other cases—not in dam work—where concrete has had to be replaced.

Mr. Lippincott: In the government dam $96,000 was charged to camp construction, and if that item is resolved into percentages and applied to Crystal Springs, that would mean $53,000; that charge does seem a bit high for a wooden camp at the dam site. I think there would be a very substantial pumping cost at Crystal Springs, but I do not know whether there would be $25,000 worth.
5591 I used a figure of $1.50 for the excavation of gravel or earth for the foundations of the Crystal Springs Dam. The figures at other dams range from $1.12 to $3.14. There would be pumping charges. They might be distributed over both the costs of excavating material, and indirectly in the form of the purchase of pumping equipment. I do not assume that the indirect charges on the purchase of pumping equipment would amount to $25,000. It is a fact you would have to pump while you were making your excavation, and you would have to keep your foundations pumped out while you were placing your concrete; you would also have to keep your pit pumped out while you were excavating for your footing trenches in the rock. The pumping charge would extend over all those operations. I do not know that interest and depreciation and operation at $25,000 on that equipment would be an unreasonable charge, as it would extend through quite a period of time, and cover many
5592 different features of the work.

Referring to camp maintenance and heating, 3.3%, which would amount to $38,000, you have the tram "camp maintenance" in there in addition to heating. You may select some of these items as giv-

ing figures when taken separately which apparently are high, but I am aware that at Santa Barbara the percentages were higher than the ones I have used. I do not mean that there was a heating charge of $30,000 or any such percent, but I mean the aggregate of the auxiliary expenses were higher there. I think the camp maintenance was higher there than it is here, when you consider the fire losses that we had, which is a camp expense. I think we charged that under losses.

Mr. Metcalf: Referring to a list of auxiliary and construction operating expenses sent from Mr. Lippincott's office, in Los Angeles; I notice a reference here, miscellaneous losses, subsistance losses, general miscellaneous expenses—that general miscellaneous expenses and operation includes the fact that to this account is credited hospital service. I thought if hospital service was included, the cost of taking care of the individuals must also be included. 5593 5594

Mr. Lippincott: I think those settlements for injuries were charged in the auxiliary expense.

CROSS EXAMINATION BY MR. SEARLS.

I didn't find any charges at all on the government work for those items. The auxiliaries on sheet 3c of the general summary of cost accounts for the construction of the Los Angeles Aqueduct, the auxiliary expense is designated as 26.72, the miscellaneous as 1.75, and the general executive 5.30. The auxiliary construction expenses have been thrown into nine main divisions. The first is preliminary 5595
engineering which constitutes 2½%. I have here a classification called service and general engineering 2.3%.

Q. I am informed that that item includes the following items:

First; preliminary surveys and investigations covering 223 miles through practically an unknown and undeveloped country.

Second: An abandoned railroad survey.

Third: General drafting room expenses.

Fourth: Consulting engineers.

Fifth: Water investigation.

I would think that that general drafting room expense was the preliminary work, and not on the construction work proper. It might be considered as general overhead. The expense for consulting engineers was not a very heavy item, and that might be considered as a general overhead. I do not think there would be as much work in the way of preliminary surveys in an unoccupied 5597
desert country like that as there would be in a country that is occupied as it is here where there are many land lines to be tied to, and all that sort of thing.

Mr. Searls: Applied to Crystal Springs that would mean about $29,000 for preliminary engineering, based on 2½%, the same percentage that was applied on the aqueduct. I reckon the 2½% on

the direct cost of the Crystal Springs Dam as figured by Mr. Lippincott. Take his direct cost and divide it by 140 and you get his direct cost as being $1,178,000. The result was about $29,000, and that would cover only the dam and the auxiliary structures.

5598 Mr. Lippincott: At the Crystal Springs Dam I would expect to have only one division, but I think you would have to have a field superintendent and a surveying party there as well. There would have to be men there constantly on the work giving lines and grade constants. If you take a curved dam with definite slopes provided for on both the upper and lower face, it would have to be very carefully located.

I think that $60,000 at Crystal Springs for sanitation and housing is very reasonable.

5599 The item of domestic water supply, 2.78%, is for pipe lines, maintenance and operation to bring water out on the desert right to the camps. That includes both the installation of a domestic water system, and its maintenance and operation. That is not only for the purpose of supplying domestic water for the inhabitants of the company but it is also for the purpose of furnishing water for construction purposes, and doing all the work necessary for the camp; for instance, if you are operating a steam engine, it would be for the boiler supply of water. I think you would find there would be quite an expense in supplying water for the construction of a concrete dam containing 160,000 cubic yards of masonry, and supplying a camp of several hundred men with water for two or three years at a time.

5600 Roads and trails: I think that $22,000 on Crystal Springs would be a reasonable charge, that is for the construction of roads and their up-keep and maintenance during the construction of the dam.

Item 5, buildings; I would put up wooden structures. The last big dam that I visited was the Elephant Buttes Dam, and at that point their construction consisted of houses that were made of stucco on expanded metal lath, and plastered on the inside. We had tent camps out at the remote pointes on the aqueduct work. In the case of the Antelope Valley we had an extremely long haul, and we had a tent camp there. I think it would cost $25,000 to put up
5601 a camp at Crystal Springs. That would be about $1,000 on 25 buildings. You would have to provide warehouses, mess houses, bunk houses, offices and buildings for some of your equipment. I think there would probably be 200 or 300 men on the job.

Telephone lines: $11,000. That would mean the operation of the telephone lines, and the maintenance of a central operator, possibly two shifts a day, and the remainder for long-distance telephone
5602 messages and things of that sort. My presumption was this, that if you are going to start in to rebuild this whole system practically at

the same time, when you do that you possibly do not have your telephone system into town to start with.

Mr. Hazen: It would take a great deal more of a telephone system to build a plant than it does to operate it.

Mr. Metcalf: You would need more service then than you do now. You would have additional telephones to your office, and your various houses, you would have to have operators, and your long-distance messages would be far greater.

Mr. Hazen: On this dam one telephone in the keeper's house is all that is needed for operation, but for construction there would be half a dozen.

CROSS EXAMINATION BY MR. SEARLS.

I should think it would cost a couple of hundred dollars a mile to build a mile of telephone line. 5603

The charge of 9.75% for equipment expense on the aqueduct is very apt to be too small on the construction of the dam. That included our caterpiller engines, and the Tufa cement mill, but that was a great economizer and paid its own way. The plant costs at the power dam that I referred to were a good deal more than 10%. The cement mill was not considered in these figures. The cost of the cement mill, and the cost of real estate were not taken into consideration in determining these percentages.

Referring to miscellaneous item amounting to 3.30% on the aqueduct: That transportation charge of labor was very low. When 5604
we had the Laguna Dam, and labor was scarce, we imported labor from Colorado; on the construction of the aqueduct, we were able to adopt the policy practically of not paying transportation for any labor. It was only in the last closing months of construction that we had to pay any transportation charges for labor. There is this feature about labor: When labor is abundant they work with efficiency; when labor is scarce they not only expect to get better compensation, but their work is less efficient. 5605

The item of small tools comes in with the aqueduct, and I think the losses for injuries is probably in that miscellaneous losses. I would expect fire losses to be in that item, too. I do not see any allowance for floods in this Los Angeles list, and I would expect them to occur in the neighborhood of Crystal Springs. I mean ordinary winter high-water when I speak of floods. What I mean by a flood is a flood that would cause loss and destruction to work. We have had some very severe ones at Santa Barbara, and at the Roosevelt Dam. At the Crystal Springs Dam we would have a 10 foot tunnel to handle the water after you had it built. You would have to have 5606
coffer dams or diversion tunnels both above and below the dam, and a flume to carry the water by the dam. That would be the first thing you would do.

I am familiar with the conditions in the neighborhood of San Francisco with regard to the rise of streams in winter. I think they had very large floods in San Mateo County in the winter of 1914. The largest flood run-off I have ever measured in the State of California were in the winter of 1914, January and February. We estimate that
5607 our flood losses in Los Angeles County in January and February, 1914, were nearly ten million dollars. I allow 40% to cover all these losses and auxiliary expenses. I would expect flood losses to be covered by a general fund which would meet all these contingencies. I do not think I can separate it.

5608 I have only figured on $5.97 a yard for direct concrete cost, and that would not take care of the flow of the streams. I do not think that would care for all these items of roads, equipment, floods, injuries, camp expense, and everything of that kind. I would try to construct the dam in such a way that the water will be handled as I construct it. The 40% which I have allowed for indirect charges, of which the item of water control is a part, is not a matter of analysis, it is just a matter of general judgment, and is also based on those specific cases to which I have referred in my testimony. I have given all the information that I consider applies to that subject. The table which I last presented shows the very great range between the direct cost of the masonry that goes into the dam, and the total cost for
5609 all features of the construction. It is a very difficult thing to make these comparisons, but I have put them together there for what they are worth. I think there might be other items than those which I have enumerated in these tables that could be included in the 40%. Of course this whole matter of making an estimate depends upon the condition of the labor market, and the material market, at the time the work is undertaken. There might be very serious delays due to strikes and matters of that kind. I would carry an omission as an
5610 indirect charge in my 40%.

My miscellaneous item was 1.75%. My percentage is a percentage of the direct charges.

Mr. Searls: I think I have a detail of that here. There were included under that heading tests, cement sacks, miscellaneous losses, reorganization due to your shut-down at the time your bond holders did not come through, replacements and miscellaneous adjustments.

Mr. Lippincott: That is the patrol of the Los Angeles aqueduct, miscellaneous losses, or reorganization, 1.2%. Almost any organiza-
5611 tion might have the same sort of an expense. The City of Santa Barbara is going through the same expense now. I think any organization that starts in to build a plant that may cost somewhere from $25,000,000 to $30,000,000 is apt to have certain periods in its program where it will have financial troubles in meeting its obligations. It is one of the contingencies of doing a piece of work. There is no discount on bonds allowed for in here; nothing for financing. I have

not considered it a proper charge against the construction of any unit structure, but it is frequently an expense that has to be paid for.

RE-DIRECT EXAMINATION BY MR. GREENE. 5612

The work at the Crystal Springs dam site would not warrant the construction of a cement plant. First, because I did not see any material there that was suitable for the manufacture of cement; second, the number of barrels of cement to be manufactured was not sufficient to justify the building of a mill. I cannot tell you what will be covered by the auxiliary charges until after the work has been actually performed, and I have had such experience in building works where I have under-estimated the cost of these works, because I did not allow for those incidental expenses, that as an engineer I do not propose to make estimates in the future, nor am I doing so at the present time, that do not contain a very substantial item of this kind for auxiliary or indirect expenses, and I have, during the last year or so, in several instances of where I have made estimates of large projects, included those amounts. One was an estimate for the City of Denver for a new water supply, and another was for the City of Santa Monica. The estimate just going in within a week, and I have added 40%. In the last analysis, it is a matter of judgment based on experience.

Mr. Metcalf: Mr. Lippincott's allowance on bringing the stone from the quarry to the dam was 10 cents a cubic yard for the tram- 5612½
ming, instead of the 25 cent allowance which he made; that was based upon the assumption that he had the necessary tramway which would be included in his auxiliary expense; that difference in cost applied to the total yardage would amount to something like $33,000. It bears upon the transportation problem and equipment.

SEVENTY-EIGHTH HEARING. DECEMBER 13, 1915.

Witnesses: R. T. English for Defendants. English
Geo. L. Dillman for Defendants.

DIRECT EXAMINATION BY MR. SEARLS. 5614

I reside in Baird, Shasta County, California, and am 33 years of age. I am superintendent of construction for the Ross Construction Co., at Sacramento, and have been with them for 18 months. During that period I had charge of the construction of a concrete bridge known as the American River Bridge, in Sacramento; at Redding, California, a five-arch bridge across the Sacramento River, and at Baird, California, a concrete arch bridge across the Pitt River. I have been engaged in construction work about 15 years, and have handled generally concrete structures of all kinds. The

first large job that I had charge of was the construction of concrete piers for the Chicago, Milwaukee & St. Paul Railroad bridge across the Missouri River at Mobridge, S. D.; there were 20,000 cubic yards
5615 of concrete in this bridge. I was superintendent of the mixing and placing of the concrete, installing the plant, building forms, etc. I designed the plant for handling the work. The bridge seat is 60 feet above low-water elevation. That was in the years 1906 and 1907. To mix and pour the concrete in that bridge cost 40 cents a cubic yard, not including forms.

That charge includes installing the plant, mixing and placing the concrete. We worked the men 10 hours, and paid the concrete laborers $2 a day. The 40 cents did not include general overhead.

I mixed and placed concrete for the Chicago, Milwaukee & St. Paul Railroad subsequently for the piers of the Cannon River bridge, 4 miles north of Redwing, Minn. This bridge had about 18,000 cubic yards of concrete, and cost 65 cents per cubic yard to mix and place, not including forms.

I constructed 3 bridges across the Mussel Shell River, in Mon-
5616 tana, for the same company. The 3 bridges are within about 8 miles of each other; the one furthest west is 29 miles from Roundup, Mont. I am unable to tell just what that job cost.

The bridge across the Sacramento River, near Redding, which I built and completed in February, 1915, is a five-span concrete arch bridge, open spandrel wall design, very heavily reinforced. It cost $1.10 to mix and place the concrete, and that includes installation of equipment and a charge for overhead, depreciation on equipment, and power charge. There were 3,000 cubic yards of concrete in that bridge.

The bridge is low, and the bank of the river on the south end of the bridge is all level land; that material was hauled to the bridge in wagons. We used pit run gravel; we set our mixer at the end of the bridge, and the mixer was equipped with Sargeant hoppers. We car-
5617 ried the material to the mixer with wheelbarrows, discharged the concrete from the mixer into Koppel cars, and the track was laid on the false work of the bridge. The concrete was transported to the forms in the cars. The bridge is 640 feet long, average haul 320 feet. It was very expensive construction in that the yardage of concrete was not great enough to warrant the installation of a large amount of equipment, and for that reason it cost more than if the yardage had been greater.

I had charge of some small structures on the Great Western Canal, 6 miles from Oroville. I was with the Ross Construction Co. at the time, but the contract was let with the Great Western Canal Co. through them. The job that I am now on is being built for the California State Highway Commission. The work is not completed, and I would be unable to give the costs. I have had charge of a

great many other jobs besides those specified here, but I think these are the principal ones.

I saw the Crystal Springs Dam of the Spring Valley Water Co. in June, 1914. I went there with Mr. Dockweiler, and spent one day. I spent 2 weeks in looking over the design. I studied Mr. Schuss- 5618
ler's testimony as to the design and construction of the dam that was used in pouring, etc. My purpose in visiting the dam was to determine what it would cost to reproduce it between the years 1907 and 1913. I talked the matter over with Mr. Dockweiler.

There is a high knoll at the north end of the dam, and on top of this knoll I would build my material bins, and install my mixers under the bins, the mixers to receive the material by gravity from the bins, and I would build one steel tower 180 feet high. I would install 3 Smith mixers, each with a capacity of 250 cubic yards; only two of these mixers to be required at any one time to pour 500 cubic yards. The third mixer is to provide against delay on 5619
account of break-downs. I would build three towers for handling skip hoists, the concrete to be discharged into the skips and hoisted to the top, there to be discharged into chutes. There would be a chute running from each tower, and from them the concrete would be discharged into a common chute supported by the cable stretched across the dam. I used 8 inch galvanized iron chutes. The concrete is then dropped and distributed by means of flexible pipe chutes placed at intervals hanging from the cable, and enough of them to be installed to convey the concrete to any part of the structure. I did not figure on the cost of the material in the dam, except the rock. I figured the rock was coming from a quarry half a mile north, and I installed a belt-conveyor to receive the rock from the crusher, transfer it across a ravine, dropping it into receiving bins. Then a belt adjacent to the macadamed road and conveying it from the receiving bins to the foot of the knoll at the dam from motor trucks. I do not think it would be feasible to install tramways, as there is a very good road there. I do not think a tramway would be as economical as the motor trucks.

I figure it would cost 75 cents per cubic yard to get the rock 5620
into the receiving bins at the quarry, and that includes stripping the quarry, quarrying the rock, placing it in the crusher, screening, washing, and conveying it to the receiving bin. Power and equipment charges are included in that as well as labor. I have also allowed for liability insurance, contingencies, etc. I did not figure on the cost of hauling rock from the bins by motor truck. I figured as the cost of mixing and placing the concrete in the dam 50 cents per cubic yard, which includes the installation of plant, cost of operating and maintenance crews, allowance for contingencies, small tools, etc., but does not include forms. 5621

I figured 8 cents per cubic yard for forms, 2 cents per cubic

yard for power, 1 cent per cubic yard for oils and waste, 7 cents per cubic yard for overhead, time-keeper, clerk hire, etc., 15 cents per cubic yard for equipment, and 3 cents per cubic yard for liability insurance. I stated that 50 cents per cubic yard included the labor on installing plant, but it did not. I have 6 cents per cubic yard for installing plant. The total on these charges alone is 92 cents. It was 50 cents for direct labor, and 15 cents for equipment. I did not consider the cost of installing a construction camp, and do not think that that should be added, because my experience has been that a construction camp with a crew of 40 men or over will support itself, and will build the necessary buildings to house
5622 the men. I mean by that that the money derived from the board of the men will pay all the expenses of the camp, including its installation.

In building this dam I figured on the exact structure that is there now, using the interlocking block system. Before making my figures I examined the drawings showing the details of the structure and its design. I did not figure on any hand labor in handling the material after it was received at the receiving bin. The material is never touched with shovels, but is fed entirely by gravity to the mixers, and from the mixers to the hoist, and there is no necessity of handling the material by hand at all. The bins would be at the top of the knoll, but I have a depressed receiving bin at the foot of the knoll to receive the material from the auto trucks, and the material is transferred from there to the top of the knoll with a belt conveyor. My figure does not include anything as to the cost of the material or the cost of transporting to the receiving bins, except
5623 rock. This 92 cents per cubic yard does not include the cost of the rock. This figure that I have made was made jointly with Mr. Dockweiler.

CROSS EXAMINATION BY MR. McCUTCHEN.

I was employed at the suggestion of Mr. J. H. Dockweiler. I had a discussion with him before I went to the Crystal Springs Dam, but I did not know what his figure on doing the work was before I went there. Mr. Dockweiler did not tell me that he wanted my figure in order that he might base his testimony upon it. After I had completed my estimate of the job, I expressed an opinion to Mr.
5624 Dockweiler about what the cost was. We worked together on the work, and agreed on the figures, and were in accord from start to finish. I cannot remember on what items we differed, but there were discussions. Mr. Dockweiler told me he was representing the City, and he did not express any opinion about the reliability of the figures placed upon the structure by the company's engineers. He
5625 did not say anything to me to the effect that the company had placed exaggerated values upon that structure. I do not remember that

he told me what valuations the company had put upon the structure in other litigations. As far as I remember, he did not tell me that he had been a witness before on the same subject. He told me he was thoroughly familiar with the Spring Valley Company's properties. I do not remember that he told me what the purpose of the valuation was, although I probably knew what the purpose was at the time. Mr. Dockweiler did not tell me that he wanted a figure from me as a basis for his estimate of cost. He told me he wanted me to figure the cost of reproducing this dam, between the years 1907 5626
and 1913. He told me that he had had experience in the construction of concrete work, and I assumed that he had. I did not base my conclusions upon his judgment, and was not influenced by his expressions in the course of our discussion of the subject any more than anybody else that made the same assertions.

We worked together, and in taking up one particular portion of the work, it would be discussed, and a price decided upon it, and when that element was under discussion we reached an agreement as to the cost of that particular element. In some cases I deferred 5627
to Mr. Dockweiler's judgment after he had proved to me by argument, etc., that perhaps he was right. It may be, perhaps, that in some instances my figures were a little bit higher, and in some instances lower than these figures which I have adopted. I think in the aggregate I was lower than these figures. I could not tell you which one of these figures I raised on Mr. Dockweiler's recommendation. I made my figures in Mr. Dockweiler's office, and not at the 5628
dam. I was working in his office, and saw him every day, and discussed all of my work with him from time to time. In some instances Mr. Dockweiler agreed with me, and the 8 cents for forms is my figure, and Mr. Dockweiler was higher than that, and finally adopted my figure. 5629

I estimated 456,000 feet B.M. of lumber would be necessary for forms in the construction of that dam, and that would cost 8 cents per cubic yard in place. I do not remember what I figured it would cost per thousand feet. I do not remember what lumber would be worth delivered on that job. I do not exactly remember the market price of lumber in 1913, but I could probably come within a dollar or two a thousand. I have never sought to advise myself about the market price of lumber during that year. Mr. Dockweiler told me what lumber was worth, and I took his statement for it. I do not remember what he told me lumber was worth here.

Questioned by Master.

My notes show $12.09 per thousand delivered at the dam site. 5630

CROSS EXAMINATION BY MR. MCCUTCHEN.

In determining the cost of forms per cubic yard, I figured on the cost of lumber at the dam as $12.09 per thousand feet. I figured

upon using sheeting No. 3 common inch boards, sized one side, and
also 2 x 4's. I figured on Oregon pine. No. 3 lumber is the poorest
lumber generally used, and I do not believe there is any poorer
lumber quoted. I am buying lumber every few days now. I am
5631 buying No. 3 common 1 S. 2 E.—sized, 1 side 2 edges for $12 in lots
of one carload or two carloads. I am buying from the Lamoine
Lumber Co., Lamoine, California, which is in the northen part of the
state. I am not buying any here in the city. I am buying from the
mill, and most of this lumber is from 6 months to 1 year old. It is
loaded at the mill, and I pay $12 on the car. I can get cheaper
quotations on lumber direct from the saw. This lumber has seasoned
some, and will not shrink so badly. I can buy lumber from the
Lamoine Lumber Co. for less than $12. I do not know who is presi-
5632 dent of the company, or how much of a concern it is. It is a com-
pany that has a complete outfit, and sells lots of lumber. Most of
it is classed as Oregon pine. White fir is an entirely different lum-
ber, and is not as suitable for my purpose. I did not get white fir in
my order, but I did get red fir, which is but very little different from
Oregon pine. A great deal of the lumber from Oregon is red fir.

5633 I bought lumber a year ago this fall from the Terry Lumber Co.,
which is not far from Redding. The cheapest lumber that I got
from them was $14 a thousand, and that was delivered at the job.
It was hauled, I think, about 30 miles by railroad from their mills
to Redding, unloaded at Redding, and then hauled to me, 1 mile, by
team. That was No. 3 lumber, and there was a little white fir in it,
but the majority of it was not white fir. White fir is lower in the
market than pine. How much lower, I could not say. I do not
know enough about the lumber market to sit down and determine
5634 the price of lumber on a job in a locality where I know nothing
of the price of lumber.

I believe San Mateo is the nearest convenient railroad station to
the Crystal Springs Dam, but I did not figure on from what railroad
station this lumber would be hauled to the dam. My figures cover
transportation on lumber. I know nothing on the amount for trans-
portation per thousand feet. Mr. Dockweiler told me that lumber
delivered on the job there was worth $12.09 per thousand feet. I
did not make any estimate other than the labor on the quarrying,
mixing, and placing of the concrete. The cost of lumber enters into
that, because unless you know the cost of forms, you do not know
the cost of mixing and placing of concrete. I knew nothing about
the cost of the lumber, otherwise than from Mr. Dockweiler. I pro-
5635 pose to use electric power at the dam, and there are power lines adja-
cent to the dam; they run parallel to the road just north of the high
knoll. I do not know that those lines were carried out there ex-
pressly for a pumping station by the Spring Valley Water Co., and
I counted on taking power off those lines. I did not know whether

those lines would have been there if a dam had not been there. I figured the power cost me 2 cents per cubic yard of concrete, and arrive at that through P. G. & E. schedule No. 110, furnished me by Mr. Dockweiler. That is a schedule of rates. It would require 641 kilowatt hours per day. I have used electric power; the last instance being on the Redding bridge. In making this contract, I did not assume that I would have to pay for power at times when my plant was idle. I know that I would not. I have installed electric motors, 5636
and bought two 20-horse motors, and one 6-horse motor last year. They were General Electric motors. I would have six motors on this job, and I know that I would need six, because I worked my plant from beginning to end. I do not remember whether Mr. Dockweiler and I agreed upon the power needed after I had worked it up. I do not believe there was any disagreement between us, and I believe 5637
we did agree to the fraction of a cent on the cost of power on that job.

The six motors would be three-phase motors. I believe the system out there is a three-phase system. I never bought a single-phase motor. The three motors I purchased were three-phase; my 20 H.P. motors cost me $265 per motor, and those are the costs of the motors which I intended to use on the Crystal Springs Dam. I believe I got that price of $265 from Mr. Dockweiler, and I believe that I checked it. I got a quotation on all my equipment; that includes the motors, and I think that he checked it. The quotation on 5638
motors I got from the General Electric Co., San Francisco. I do not know where their office is. I have never been there, and cannot say who is their representative. I sent a man from Mr. Dockweiler's office down to get the quotation. That was before Mr. Dockweiler had given me the price on motors. After I had sent the man down to the General Electric to get the price list, I took from Mr. Dockweiler the cost of these motors, as I wanted to be sure that I had the right price, and Mr. Dockweiler told me that the price was right, and when he told me, I adopted it, and not before.

There were to be three 20 H.P. motors, and one pump motor— 5639
8 H.P.—price $160. Then there was one 30 H.P. conveying motor, $310, that operated the conveyor belt which lifts the rock from the point where you would dump it up to the point where your mixing plant it. The distance is 110 feet, and requires that much belting to reach and not return. I have not the actual lift in feet. The notion to put that conveyor there is my notion, and Mr. Dockweiler agreed with me as to the wisdom of that after I had explained it to him. As to the application on this particular job, I do not know whether this conveyor belt was new to Mr. Dockweiler or not. I 5640
thought of it the minute I went out there, and he approved of it after I had explained it.

I used a 20 H.P. motor to hoist my concrete from the mixer.

There would be a 30 H.P. motor which operates your conveyor, and
an 8 H.P. motor which operates your pump, and a 20 H.P. motor
which hoists your material. Then one motor runs each one of the
Smith mixers, and each of those is a 20-horse motor. It would re-
quire 641 kilowatt hours a day to operate the six motors. There
5641 would be delivered to the 30 H.P. motor 200 horsepower, and it
would be delivered to so many theoretical horse-power. I figure
about 83 1/3% of the capacity of the motor would be required to
lift that load. I figure on 1½ yard batches of concrete, but have for-
gotten just what the weight of my load was. I believe that the
figures that I made regarding this were in connection with the com-
pany which quoted me the price on the conveyor complete. It seems
5642 to me that they gave me the horse-power required to handle the con-
veyor they quoted. I have set up conveyors and handled them with
motors; judging from other conveyors I have handled, I would know
without any figures at all about as close as they do the size motor
it would require to handle that conveyor.

The monthly cost for the mixing, placing, and raising the rock,
would be $304.16. 377 days is the total working time, but these
5643 motors would not run all that time, because it only takes 314 days
to pour the concrete with the equipment that I have. There are 157,000
cubic yards in the dam, and it is my opinion that the electric power
to do the mixing and placing of the concrete would cost $3,140. That
would also cover the lifting. The oil and waste are to be used in
keeping the machinery in order. The last white waste that I bought
was in small quantities at 5 cents a pound. I have bought oil, and
for this work I would buy motor oil. I could not say offhand just
what it would cost me. I know the cost of oil in this market. I do
5644 not know the cost of dynamo oil in this market. I do not draw a
distinction between motor oil and dynamo oil. The oil that I buy is
called motor oil. Dynamo oil is the same thing. The motor oil that
I use mostly is the Standard Oil Co.'s motor oil, but I would not be able
to tell you offhand the cost of all of these oils. I got these prices on
oils at the time, and agreed with Mr. Dockweiler on that 1 cent.
That was my original figure, and if I am not mistaken, his figure
originally was the same. The 7% overhead represents time-keeper,
5645 clerk hire, office expenses on the job, etc. The field overhead includes
time-keeper, clerk hire, office expenses, telephone, etc. I have had
occasion to keep field overhead. It is about 2% of the total contract
on our Sacramento job. The total contract was $50,000, and there
was 3,000 yards in the job. I am unable to give you the total cost
of the concrete in place on the Sacramento job, as I do not remember,
although at the time I had something to do with those figures. I
5646 had full charge of the field overhead, field expense, the time-keeper
and clerk, but I have been building two or three other bridges since
then, and I cannot carry a head full of figures and segregations on each

bridge. I can carry those particular figures, because I referred back to my notes to see what the cost of mixing and placing the concrete was, and that is the principal thing I watch on every job, and is what I concern myself with most.

The whole Sacramento job was $50,000, and as there were 3,000 yards, that would be about $17 a yard, which included all the excavations; they were difficult under-water jobs, coffer damming. 5647
I arrived at the item of 7 cents from my past experience. I cannot segregate it here any more than that it would amount to $10,000 on the job. I do not know that I can give you my mental operation in arriving at the 7 cents a cubic yard for that item. There are times when there would be about 70 men in my force of laborers. Then I would also have the quarry crew of 38 men in the same camp. 5648
I would never have more than 70 men on the dam, and I would not have that many after my plant was installed. After the installation of the plant I would have 37 men at the dam. On my operating crew I would have 4 men, hoisting engineers at $6 per day; I would have 1 laborer at my receiving pit receiving the material from the auto trucks; 1 laborer at my receiving bin receiving the material from the conveyor, and attending to the switching of the conveyor; 4 laborers at the stone and sand chutes; 4 laborers handling the cement; 1 laborer in the hoisting tower keeping the chutes in shape; 5649
10 laborers in the dam placing concrete; 1 foreman of the operating crew; on the maintenance crew I would use 1 superintendent, 1 master mechanic, 1 blacksmith, 2 riggers, 1 electrician and 2 helpers. I would have 2 carpenters and a helper handling the forms. Carpenters would be paid $5 per day, and the helper $3. The laborers would get $3.

Referring to the 7 cents per cubic yard overhead; I would have 2 material clerks, and one time-keeper, which is all the office force necessary. In that 7 cents overhead is office expenses. I do not know how you can arrive at them otherwise than by experience. Mr. Dockweiler agreed on that to the fraction of a cent when we finally finished our discussion. I have no recollection of any differ- 5650
ence between Mr. Dockweiler and me on that figure. A very small portion of that 7 cents was represented by the time-keeper and two material clerks. A great deal of expense there would be connected with the auto haul; that means the transportation of men, etc., from San Mateo. There would also be the building and maintaining of an office, and the telephone wire. It seems to me that Mr. Dockweiler advised me that there was a telephone there. I include the superintendent in the maintenance crew, and a foreman in the operating crew. I do not include the superintendent in the overhead, and it depends on the conditions of the job whether I would do so or not. In this case I considered that the superintendent would be more interested in the maintenance crew than he would be in the 5651

ordinary daily operation of pouring concrete, which would be very
simple with the equipment that we have here.

The total cost for equipment on this work would be $22,803.
That includes simply the machinery for placing the concrete. The
cost of liability insurance depends upon the nature of the work. In
the mixing and placing of this concrete it would be about 7½% as
of 1913. There is a difference between today and 1913, as the Em-
ployers' Liability Act is in effect now. Mr. Dockweiler told me that
5652 it was not in effect then, and I also knew it otherwise. Insurance is
higher now than it was in 1913. An insurance company takes the
5653 stand on high bridges that it is more dangerous to pour concrete than
it would be on this dam. There is a fixed insurance rate for mixing
and placing concrete, but I do not know what it is. I know that it is
higher now than it was in 1913, because I know that insurance rates
generally are higher now. I have counted on a rate of 7½% on my
payroll, which figures out 3 cents per cubic yard. The 50 cents per
cubic yard is the cost of mixing and placing, and my rate of 3 cents per
cubic yard for concrete is the installation of the equipment, and all the
5654 labor required on the job. I have here in my notes: The present
liability is 7.5—the liability in 1913 would be 6. I got that from the
insurance company, but what company I do not remember. I got it
through some of Mr. Dockweiler's office force. I think that 6% on
the labor crew is 3 cents per cubic yard, and I have included protec-
tion for the men who are installing the equipment. I cannot call to
mind just how I arrived at that insurance, and I haven't it here,
any more than the rate I have used.

5655 I used a Duplex pump when I estimated on the work, but I have
not noted the size here. I have not noted its capacity, but I think
it would take 30,000 gallons of water a day to do that work. I have
allowed for a 100,000 gallon redwood tank. I would say 50,000
gallons would be the maximum that I would use. The water would
5656 be used principally for the purpose of wetting the concrete. That is,
for mixing the concrete, and pouring it in the mixers. I would use
it in keeping my concrete wet down, especially in warm weather
after it had been poured in the dam. You would not do a great deal
of work in the winter, and I do not suppose you would work at any
time when we would not have to use water to wet the concrete. I
would use water for keeping the concrete wet after it was placed
in the forms, but not a great deal. I would say 500 gallons per day
5657 would properly season the concrete on the whole work for the day.
That water applied to the concrete would be on the finished form
that was poured previous to the day on which we were running, and
the object of that is to properly season the concrete. That 500
gallons a day added to the water actually put in the mixers would
be all the water required on the dam. I would not be in a position
to say how much water would be required to make a cubic yard of

concrete. I do not know the quality of the sand nor the nature of
the rock; there is a great deal of difference in the amount of water
that is required. That difference does not result in a great deal
of difference in expense; you install your equipment to furnish your
water, and you have the water there, so that there would be no 5658
additional expense.

I was given to understand that there was a reservoir above the
dam at the time the dam was built, and that there was sufficient
water to furnish all our needs. I could not say how high that water
would be lifted. It would probably be 140 or 150 feet. The tank
would probably be 30 feet above the mixing works, so the water
would flow into the mixing equipment by gravity. The dam is 140
feet high, and I think the mixing plant is about 30 or 40 feet higher
than that, and the water tank is still above that, but I am not pre- 5659
pared to say that it is 200 feet in height above where we would get
the water, as I do not know where that place is. At the time that
this was prepared, I had the data on that, and submitted it to the
manufacturers, and asked them to give me prices on a pump and
a motor that would lift the water. They told me that under the
conditions that I gave them at that time, this pump and motor would
furnish water. I do not know what the capacity of the pump was,
and I did not allow anything for slip or frictional loss in the pump.
I do not think I should, as that is up to the manufacturers of the
pump. I did not ascertain whether there would be any loss by
slippage. That 8 horse-power would operate 24 hours per day. The
6 cents a yard for installing plant would be all this plant that I 5660
have referred to. Those were my figures, and I do not remember
whether they were Mr. Dockweiler's too, or not.

I would use some lumber in installing my equipment; my storage
bins take 60,000 feet rough Oregon pine. I would use 2 x 12 plank,
8 x 8, 10 x 10, and 12 x 12 supports. I do not remember the dimen-
sions of the bin, nor how high they would be; it would all depend
upon the quantity of material that you wanted to store. I figured
on all that 18 months ago, but I have figured a great many other 5661
things since then and I cannot remember.

The field tower would be located on the top of the high knoll at
the north end of the dam, and would be 180 feet high from its found-
ation. There would be a half a mile haul for the rock, which would
be delivered from the motor trucks at the foot of the knoll on the
up-stream side of the dam where the macadam road runs around
the knoll. I would take it on the present road, and I believe it is a
half a mile from the quarry to the foot of the knoll on that road.
Mr. Dockweiler gave me that measurement, and I am not quite sure 5662
of it. I crossed the canyon with a belt conveyor. At the point where
I build my bins to receive the crushed rock from the quarry, the
road turns, I think, probably 150 feet, and then turns again, and

there is a short bridge crossing a little ravine; instead of hauling my material around there, I put in a belt conveyor to cross the ravine. I took the stand that the material would have to be elevated anyway from the quarry to the road, and that it was just as short a distance between the crusher and that point in the road as it would be to go on up further across the bridge with the auto trucks and place the elevating conveyor there.

I know there is a cut called the Howard Cut, and as I remember it, it does not conflict at all with the macadam road. That road goes across the top of the dam, but I do not go to the top of the dam; I stop before I get there. I know nothing about the transportation of rock from the quarry to the dam. I established my receiving bin at the dam at the point where the road turns to go around the knoll and over the dam. I know nothing about the route
5663 that I would use between the receiving bin at the quarry and the receiving bin at the dam. I was simply told that that macadam road was available to use.

I have a conveyor at the quarry, and another conveyor at the dam. To get the material from the lower bin to the upper bin would be the height of that knoll, but I do not remember what that is. The lower bin would not be below the base of the dam as it is now. It would be about level with the crest of the dam as it is now. I think there would probably be about a 60 foot lift from there to the top
5664 of my bins. I would lift enough material a day with that 30 H.P. motor to furnish 500 yards of mixed concrete. I used the same equipment to lift the sand as lifted my rock. I would lift 500 yards in 8 hours with an 8 H.P. motor—60 feet. In arriving at this equipment, I have simply asked the manufacturers to give me a price on the equipment as per my specifications submitted to them, including a motor to handle it. I did not go into the details of this at all.

5665 The sand would probably weigh somewhere about 2700 pounds to the yard, and the rock probably 2500 pounds. The cement will weigh say 400 pounds to the barrel, or about 3600 pounds to the cubic yard of concrete in place. I would raise, therefore, 900 tons with that equipment in 8 hours. I have seen that done, and it is done right along. I cannot say that I have seen a 30 H.P. motor raise that much in 8 hours, but that is what the manufacturer allowed to me and guaranteed that it would do.

I have allowed for three other towers; one in front of each mixer. The mixers were to be on top of the knoll, directly under the material bins. After the material is mixed and comes from the
5666 mixer, it is discharged into the skip-hoists, one in each tower, raised to the top of the tower, and discharged into a chute, this chute entering into a common chute located about in the middle of the dam, and supported by a cable from the steel tower. At the point where the material enters this common chute it is 180 feet above the crest of

the dam. The south end of the chute is just above, or about at the elevation of the crest of the dam, and the first material put into the chute as it left the main chute would fall 140 feet. This drops through a flexible pipe which is at all times on a curve, and is full of concrete, so that the aggregate does not part. I know this from experience, and am using such an apparatus on the Pitt River bridge 5667
now. I have known of its use in dam construction in several instances which I cannot recall now, and I have seen pictures of them in every technical magazine I pick up.

The book which I have is book "D" of the Spring Valley Water Appraisal, from Mr. Dockweiler's office.

A flexible pipe is one the joints of which are loose, so that the pipe will bend like a rubber hose. The pipe is not inserted in the chute; the first section of the flexible pipe is larger. It is hopper shaped, and receives the concrete from the main pipe. The material flows out of one pipe into the other pipe; one is a rigid pipe, and the other a flexible pipe. The material falls, say a foot perhaps, before it enters the flexible pipe. 5668

We dump some material into a chute the top of which is 140 feet above the point at which we want the concrete delivered. At this point, 140 feet above the point of delivery, there is a flexible pipe hung from the same cable that the rigid pipe is hung from; the concrete in discharging from the rigid pipe, enters directly into the flexible pipe. The gravity system for pouring concrete has developed for the last ten years, and is in general practice all over the country. I do not remember of noticing the gravity system used in San Francisco. I do not remember having seen concrete delivered into a chute at a height of 140 feet above the point of placing, but the height would make no difference. You could get to the point where it would 5669
be prohibitive.

I believe the first time when I saw that photograph which I handed you was this spring when I dropped into Mr. Dockweiler's office. I have seen photographs of concrete being poured through chutes, and it is not anything new for concrete to be poured through chutes for short distances or long distances. It is not good practice to simply discharge it out of a chute into the atmosphere and let it separate, because your course aggregates separate from your mortar. In other words, you have all your cement in one place, and the other materials that go to make up the concrete in another place. 5670

I do not know that I have ever seen a use of this on a dam, but I undoubtedly have seen a publication in which it was stated that it had been used on a dam. I could not say in what publication I saw it.

I have been in California two years the first of this coming January, and I have seen a concrete dam in the course of construction, but I have never seen this system used on a concrete dam. I saw a concrete dam in the course of construction at Cannon Falls, Minn. It was

a large dam of heavily reinforced concrete, and the work was con-
5671 ducted under the supervision of a first-class engineer. I have known of a great many concrete dams in the course of construction, but I cannot recall them now, and I do not remember any specific instances where I have been on the work while they were being constructed. I do not know that I ever heard any engineer or constructor say that he had used this system in the construction of a dam. The equipment that I am using here has been well-known to constructors for years, and I do not know that there is anything secret about it. It undoubtedly has been in dam construction, but my experience has been mostly on bridge construction, which does not differ from concrete dam construction. I would not say it is identical, but it is similar. Methods in pouring concrete in one would be usable in the
5672 other. I have never been on dam construction of this nature.

At the present time I am superintendent of construction of what will be, when completed, the longest concrete arch in the State of California. The bridge was designed by the California State Highway Commission, and they have an inspector on the job; I represent
5673 the contractors. The contractor is not in attendance all the time on that work. There are two partners, Charles R. Ross, of Sacramento, and Geo. G. Pollock, of Sacramento. I have seen one of them twice since the work was started, and the other one four times.

I built the concrete arch bridge at Redding, California. I was the superintendent of construction, and represented the contractors on the job. There was an inspector on the job who was an engineer. Mr. A. V. Saph designed the bridge, which was being built for the City of Redding. There were 3,000 yards of concrete in there. That is the greatest yardage in any piece of concrete work that I have been
5674 identified with in California. The greatest yardage of any concrete work with which I have been identified anywhere was the Missouri River bridge for the Chicago, Milwaukee & St. Paul Railroad. I was the superintendent of mixing and placing the concrete. There was another superintendent on that job, but I was independent of him. He was an engineer in charge of the work, and I was his subordinate. That work was done in 1906 and 1907, and I was about 24 years old at that time. That was not my first work in charge of a gang of men. I started in working in a crew in construction work when I was 15
5675 years old. On this Missouri River work I had foremen under me.

Overhead: As used here I mean simply expenses incurred in the way of office expenses, time-keeper, material clerks, and general small expenses that are incurred in carrying on work in connection with the business end of the work. The word "overhead" which is put down at 7 cents per cubic yard in this statement is my expression. I use the word every day, and know what it is, but it is pretty hard for me to explain it.

One inch lumber is quite generally used for forms, but I do not

know that I ever heard of its being used in a piece of work of this magnitude. I do not know that I have ever seen a piece of work of this magnitude under construction.

The first work that would be done in connection with the forms 5676
would be setting 2 x 4's, using them as studding on the outside and inside walls. These 2 x 4's I would set plumb, and 18 inches center to center on the line of the dam. I would use 2 x 4's 20 feet long, and would nail my 1 inch boards to them for the sheeting. This form is identical for the upper and lower sides of the dam. I set those two forms 20 feet high; I would then build forms in sections, making my sections 6 feet wide and 7 feet high, using 2 x 4's for the studding, and inch lumber for the sheeting. I would build these sections so that they would assemble and fit together to make a form for the interlocking blocks; then I would set some of these and start pouring. I have allowed 2 x 4 bracing to keep them from falling over. For the first layer of blocks they would be braced back to the ground—they are only 7 feet high—and after some of the blocks had been placed, they could be braced to each other, or wired through. The outside form would be wired to two wires already imbedded to some of the 5677
inside blocks, making the outside blocks hold the forms when some of the concrete was poured. After some of these blocks had been poured, I would remove the forms, which are built in sections, and re-set them. Some of the blocks would not require any forms, for the reason that the surrounding blocks would make the form for the center block. In my opinion, 2 x 4's would be heavy enough for that work. The concrete is poured in small sections of 350 cubic yards, and the pressure is not great against that form.

The lumber I would unload at the side of the macadam road, as near the crest of the dam as I could get it. A great deal of the lumber would be simply unloaded and slid down into the hole to start the outside form; the forms for the interlocking blocks would be built in sections slid into the hole—two men could handle them and set them up. I allowed two carpenters and a helper. One man could distribute the lumber. 5678

I would pour 500 cubic yards of concrete a day, and there are 350 cubic yards in a block. A contractor in doing that work, if he installed his outfit to pour 500 yards, would probably build his blocks to handle 500 yards. I require for sheeting and studding of the forms of the concrete blocks 44,000 feet of lumber; I use 40,000 feet more of studding for bracing, and I figure this lumber can be used 10 times after it is built in sections. I start my carpenters to work 36 days before the concrete is to be poured.

I am unable to say what the cost was of the finished work on the piece of concrete work that I said represented a cost of 40 cents a cubic yard for pouring and mixing. I was superintendent of the mixing and the placing of the concrete on that work. I am unable 5679

to say what the finished cost of the work was where the expense of pouring and mixing was 65 cents a cubic yard.

On the three bridges that I constructed across the Mussel Shell River, I did not use this system because the yardage was not great enough to warrant the installation of a system of this kind. The reason that I cannot tell you the finished cost of any of these pieces of work is that my biggest work has been done for the Chicago, Milwaukee & St. Paul Railroad, and a superintendent in charge of construction is not in a position to know the cost of the finished work. In these works that I did, as a general thing I know whether the contractor made or lost money. I do not know just what the finished cost of the
5680 work on the Redding bridge was, though I did know at the time. I would not be able to say exactly what the finished cost was on any piece of work with which I have been identified as superintendent. I have the cost account of finished work, but I was generally starting another bridge, and all I looked for was to see whether we made or
5681 lost money.

I have never had to remove any concrete work after it had been placed, but I have heard of its happening. The cause of it is the inefficiency on the part of the men handling the work. In a business of that kind there are delays incident to the breaking down of machinery and equipment. That happens more frequently on equipment that has been used for some time, but not very frequently on new equipment where you are using electrical power. I have allowed 20% for delays. When this machinery is broken down, I am at no expense so far as the operating crew is concerned; they are laid off, and you do not have to pay the crew when they are not working. If there were an interruption of current to supply the power to the job for say less than an hour, you would be to an expense for labor during that time; if for over an hour, I would lay my men off. If the delays were over
5682 an hour, there would be no expense for operation, but there would be an expense for the maintenance crew of $44.50 per day. My 20% covers delays. I allow 314 days actual working time of the operating crew, but I have allowed 377 days actual working time of the maintenance crew, figuring that they will be working all the time that the operating crew is working, and all the time that we have those 20% delays. I have counted on laying 500 yards on every one of these 314 days. In my experience, 20% is about the amount of delays that you would have, using the equipment that you are using here. In other words, you would only get 80% efficient time. I am not charging myself with any expense during that 20% of the time, except the expense of the maintenance crew, and that is all the expense that would be incurred.

5683-5684 Mr. Dockweiler: The Howard Cut is for the purpose of forming a cut-off wall to intercept whatever water possibly might seep through that ridge or backbone of the hill that was left, and which joined to

the main chain of mountains with that knoll; that would be there and available. The facts are that that Howard Cut was filled up with concrete, and then on the reservoir site a dam embankment was built up to bring it up to an even surface, but there was a slight depression there, and that place could be utilized for a road.

Mr. Hazen: That is where you and I differ, Mr. Dockweiler. The saddle was there, but this cut they went away down for, was deep, and excavated, and then it has an earth dam with a concrete core with some 5,000 or 6,000 cubic yards.

RE-DIRECT EXAMINATION BY MR. SEARLS.

I did not include the water for camp purposes. I do not know what the reservoir was that I was informed existed there before. I designed the equipment and the method of pouring the concrete on 5685
all the jobs that I have spoken of. On only one of these jobs did we quarry our own rock, and I designed the quarry there. There would be no comparison, whatever, between the finished cost of work on these bridges and the finished cost of work on a dam of this size.

RE-CROSS EXAMINATION BY MR. MCCUTCHEN.

That would be for the reason that on this dam we have a very large mass of concrete, and the conditions are ideal for quarrying. On bridges we have water to contend with, and false work to build from pier to pier, and on the bridges built in the last three or four years they are all very highly reinforced, with a great deal of form work, and the cost is not to be compared. This job is so large, and there is such a vast amount of concrete to place in one particular spot, that it is hardly comparable to the finished cost of bridge work at all. 5686

I can give you a very general approximation of the finished cost of work with which I have been identified. The reason I cannot give these finished costs is on account of the costs of material, something that I have not had a great deal to do with. The comparison of the cost of labor would be very wide. You could hardly compare it at all. It has never been my privilege to have the chance to build a concrete structure under the ideal conditions that we have here. I would certainly like to have the privilege.

Witness: Geo. L. Dillman for Defendants. Dillman

DIRECT EXAMINATION BY MR. SEARLS. 5687

I have had something to do with concrete work, in a way, for 28 years. The first few years it was on small railroad structures when concrete was beginning to replace masonry, ashler and rubble. The largest dam of which I have had charge was the building of the power flume at Oregon City. I have put in concrete work in the San Joaquin Valley, and in the foothills, head walls for river diversion, small dams

for other diversion, and in a general way, I know how concrete is made today, and also the history of the change in making concrete. When I first became acquainted with concrete, the alleged authority on such work was General Gilmore, and his method of mixing, which was known as the dry mix, was supposed to be very necessary, an excess of water being considered deleterious. Later they found that this dry mix was not only an added expense, but did not develop the highest strength of concrete as well as a wetter mix. I think that a dry mix was used on the Crystal Springs Dam, on information and hearsay, as I was at Crystal Springs Dam in the early 90's, and saw the lay-
5688 out and equipment, but they were not working that day. I remember that the lay-out was a fairly good one; the tracks, cars and mixers were in place. One thing that is plainest in my mind are the large cubical mixers, which were the first cubical mixers I ever saw.

The method of making concrete, while it varies considerably for the different purposes for which it is used, is very largely similar, whether it is intended for a diverted syphon, a road or railroad crossing, head walls or dams or foundations. It is simply a method of manufacturing rock out of cement and other materials. The other materials used are broken stone or gravel. There is dispute among engineers as to the value of these materials, but in my experience, gravel has all the value of broken stone, and an added value in being a little bit cheaper to work. I think, too, it takes a little less sand and cement. The result is satisfactory no matter what material is used, if they are properly used and put in place.

In reproducing the Crystal Springs Dam, I have used a method different from anyone else here, but I think it is a practical method of getting material. I have considered all material, except the cement, as coming from Niles or the Livermore Valley. A contractor, as a general thing, can be considered as an assembler rather than as a
5689 manufacturer of parts, and if he can buy his material cheaper than he can produce it, he would better do it. In reproducing the Crystal Springs Dam, I reproduced the identical structure, in the identical location, and on the identical lines as built. The only change in my method is in the use of gravel instead of the rock that was used. The rock has turned out well, and I have no criticism to make, but I would be better satisfied to start with the gravel in the vicinity of Niles, and I would expect a better structure than to use the quarried rock in the vicinity of the dam.

The interlocking blocks have no special value to me. They would require additional forms only. I have allowed in my forms enough to make these blocks, but I should not reproduce them if I were to rebuild the dam. I should pour that concrete, make it as nearly a monolith as possible. The section of the dam is such that the only benefit of the curved form is in taking care of temperature stresses without rupture, and I see no benefit in the block form. The block form has

been an expense without adding value. There is a crack from the setting of concrete going right through these blocks. It is not a dangerous crack, but it shows that the blocks themselves are not independent.

Summary of George L. Dillman's estimate on Crystal springs Dam introduced and received as "Defendant's Exhibit 113".

The table is a summary of the various expenses of building this concrete. I have taken cement at San Mateo at $1.60 a barrel, and it 5690
should be $1.65, because I have added 5 cents for handling from cars to the warehouse at San Mateo. I have seen it stated somewhere in these estimates that there were 1.24 barrels to the cubic yard. That is a fairly rich mixture, rich in cement, and certainly would not be exceeded in practice. The $2.05 per cubic yard of cement is right; that is the cement at San Mateo in the warehouse. For sand and gravel I have figured 80 cents per ton, and I think in practice that could be considerably beaten. The mixture of sand and gravel sufficient for a cubic yard of concrete I have taken as 2700 pounds per cubic yard.

I have some corroborative figures on actual purchases of cement 5691
in fairly small quantities. The Western Pacific purchased some cement f. o. b. San Francisco in 1910 at $1.85, and in 1912, $1.70; that was net. I am informed, and believe, that the Highway Commission is buying cement at $1.65, or $1.66 a barrel, but this cement order or contract is a very desirable one, over 200,000 barrels of cement, and from what I know of cement manufacturers, I think they would very materially cut this mark, although each one of them will state that they will not. I have heard, and believe, that there was a bona fide offer to furnish the cement for the Hetch Hetchy Dam at $1.30 a barrel f. o. b. San Francisco. This corroborates my belief that on a large order of cement of this kind the current quotations for carload lots should be very materially cut, but if this were not so, my method of constructing this dam, which would furnish just as rich a mixture as was used, 1.24 barrels to the cubic yard, would effect a saving which would more than make up for any possible higher prices for cement.

The sand and gravel mixture for a yard of concrete will weigh about 2700 pounds to the cubic yard. This price is for sorted material at San Mateo. It does not make much difference whether this material is sorted at the pit, or at San Mateo, or at the dam. The gravel pits of Niles and the Livermore Valley are operated in a large 5692
way by steam shovels and conveyors, bucket conveyors to screens; these screens are barrel screens, and are set on an incline and revolved. The material is poured in at the upper end. The first section of the barrel is finely perforated for sand; the next is more coarsely perforated, and in that way you can get any size gravel you want. The refuse flowing out at the lower end of the barrel, being commonly cobble stone or coarse gravel, I would use very largely if I

were making the specifications. They would take the place of plums in concrete, and would fill a very desirable volume, but the saving would be in the amount of cement used, because there would be less finer material. The mixture would be based on the finer gravel, the sand and the cement, using a mix which is said to have been used here of about 1—2—6 one of cement by volume, two of sand, and six of ballast.

Questioned by Master.

I would use the 1—2—6 mixture, and then throw in as much of the cobble stones as it would receive. The small cobble stones I would put right through the mixer. Anything above the size of my two fists would probably be segregated and put into the dam separately. This matter of using plums is a very good one; often-times plums are derrick material, and I think the practice is quite usual, but I think the actual volume of these cobble stones would equal the ordinary
5693 volume of large plums in cyclopean masonry, as it is usually run. This would make the cost of the aggregate $1.08 per cubic yard, for the sand and gravel. I am not making any reduction in this price for the cobble stones. I only cite it as an added economy, and therefore extra leeway in constructing this work.

Mr. Hazen: I think I use 2600 pounds per cubic yard for sand. The gravel is usually a little heavier. If I had used 2700 pounds for sand, my figure would have been increased a little. It seems to me Mr. Dillman has not material enough to make his concrete in his estimate.

Mr. Dillman: A cubic foot of concrete weighs about 130 pounds. It depends upon the material of which it is built.

Mr. Hazen: We have never accepted anything less than 150.

Mr. Dillman: I have never made concrete that way, and have never seen concrete made that way, 150 pounds to the cubic foot. I have weighed some concrete to get that information, and I have never weighed concrete that weighed over—it figures a specific gravity of 2 1/6, that is about 133 pounds.

Mr. Hazen: I have also weighed a great deal of concrete, and I
5694 think I have never weighed it on my work less than 148, and from that up to 155. We have regarded anything below that as inefficient.

Mr. Dillman: There is a good deal of difference in the weight of rock and sand. I have taken this 2700 pounds to the cubic yard of mixed material; that is more than a cubic yard of sand would weigh, and more than a cubic yard of gravel would weigh. In the finished yard of concrete, you would not use a full yard of gravel, and a corresponding amount of sand—you would get a greater bulk; the material shrinks some from the aggregate, but it takes something like .9 of a cubic yard of ballast, and say, 1/3 to ½ a yard of sand, and a barrel of cement to make 1 yard of the finished product. The 2700 pounds also checks my experience; it also checks information that I

got from the Niles Sand & Gravel Co., and which I have accepted as being correct. If it is wrong, my figures are wrong to that extent, but the effect would simply be to reduce the contractor's profits, not to eliminate them or effect loss. Hauling can be contracted at 20 cents a ton mile from San Mateo to the dam site. I say this from my knowledge of hauling prices in the state generally, and this is an exceptionally fine hauling contract. There is something over a million ton miles, which, at 20 cents a ton mile will amount to $200,000. It can be done for that price, and a magnificent profit made by the contractor who properly handles his equipment, and the equipment entirely wiped out on the job.

There is plenty in this price to pay $5,000 or $10,000 worth of 5695
repair work if it is required. In my experience in contracting in this state, and in hauling over roads, the county maintains the road. The contractor has never, in my experience, been required to repair roads, or to put up money for the maintenance of roads; he has done it in some cases as a matter of cheapening his own hauling. There is plenty of leeway in this 20 cents per ton mile, however, to do all that sort of work; the material hauled per yard of concrete would be the 2700 pounds of sand and gravel, and 500 pounds of cement, which would make 3200 pounds; the additional weight of the finished concrete would be the water in crystallization, which would make the finished concrete weigh something more than 3200 pounds. I do not know how much that is, as I do not know just how much water would be used.

Mr. Hazen: It is about 30 pounds of water to a barrel that stays with the cement.

Mr. Dillman: That is all that would stay; that is all there is to it.

Mr. Hazen: The 3200 pounds does not check. There is 2700 5696
pounds of sand and gravel, 500 pounds of cement, and 38 pounds of water; that is 3,238 pounds. Now, if the work weighs what I think it ought to, what I think this dam does weigh, 4,050 pounds per cubic yard, we are 800 pounds short. In other words, you have only .8 of the material; 3200 pounds per cubic yard would be 118 pounds per cubic foot, instead of 130.

SEVENTY-NINTH HEARING. DECEMBER 14, 1915.

Witnesses: Geo. L. Dillman for Defendants.
J. H. Dockweiler for Defendants.

Questioned by Mr. Greene. 5697

These prices for cement purchased by the Western Pacific were the prices, I think, f.o.b. Oakland. I do not know what the cement cost them on the work. I only put that in as a fact generally corroborative of my price in my acceptance of the data from the City At- 5698
torney's office. I do not know that these prices are representative as

paid by the Western Pacific during the period in controversy, and I do not know that they are not. The Western Pacific did not buy a great deal of cement. Their concrete work was done by contract, and the cement was largely purchased after the fire of 1906, which put up the price of cement in this market by the excessive demand, and most of the cement that went into the Western Pacific structures came from the East, and cost them \$3 or \$4 a barrel. Most of it came from Ogden, I think. These are the only prices I know. I do not know what the freight rates from Davenport, or bay points, is to San Mateo. I took it for granted this cement would cost \$1.50, and 10 cents freight to San Mateo. That is what I think it could be bought for, in spite of the fact that cement contractors will state otherwise.

5699 DIRECT EXAMINATION BY MR. SEARLS.

The Niles Gravel Co. say that their gravel mixed, including gravel and sand, for a cubic yard of concrete weighs between 2600 and 2700 pounds. The Grant Gravel Co. gave me another quotation, and their gravel mixed, coming from the Livermore Valley will weigh between 2900 or 3000 pounds. They will guarantee it to run never more than 3000 pounds. Rhodes—Jamison, Maniger, informed me this morning that the gravel mix and the crushed rock mix that they put on the market for concrete weighs between 2800 and 3000 pounds, and has never exceeded 3000 pounds. That is for the gravel and sand in the concrete. The American Civil Engineers' Pocketbook, on page 579, says "Sand, gravel and clay mixed, dry and compacted, weighs 100 pounds per cubic foot;" also that clay dry and compacted weighs 100 pounds per cubic foot. The sand, gravel and clay, with the clay out, will not weigh more than it does with the clay in, because clay is a very finely divided material, and would fill up some of the interstices of the sand, so that so far as the American Civil Engineers' Pocket-
5700 book goes, they are authority for the sand and gravel mixed dry and compact weighing 2700 pounds per cubic yard.

Mr. Hazen: There are plenty of references in the American Civil Engineers' Pocketbook on the weight of concrete, which we are prepared to accept.

Mr. Dillman: The American Civil Engineers' Pocketbook says, from 140 to 155 pounds per cubic foot for concrete. I don't know just where the 140 is in the pocketbook, but it is there. Here is a statement of the material that was shipped, just sand and gravel mixed, and while the pocketbook gives other weights, this fact is given as directly corroborative of my weights. I have not weighed a great deal of concrete, and I do not know what the water is. I have weighed some concrete, and have never gotten any weights in excess of a specific gravity of 2 1/6.

5701 I think the concrete in the East, where they use heavy iron rock,

would probably weigh more than the concrete here with a lighter weight rock. The very heavy concrete that is cited is cyclopean masonry which takes in from 25 to 40 percent of boulders absolutely solid. These weigh more per unit of volume than any concrete that is made. In this dam, the concrete would not necessarily be much compacted. The up-stream face of this dam would be compacted, but except for a depth from that upstream face of about 10 feet the structure would be safer if the material were not compacted; in other words, the seepage that got through that face should drain off without creating pressure elsewhere in order to follow out the hydraulic principle, part of which is any leakage or seepage getting through your hydraulic tight base should be so released as not to do damage elsewhere. If this dam were made tight at the down-stream face, and not at the up-stream face, the dam stresses would not apply, and the so-called gravity section dam on that analysis would prove absolutely unsafe by the mathematical analysis resulting from a tight down-stream face instead of a tight up-stream face. It does not need to be compacted, as there is no frost here to get in and disintegrate the concrete by the action of water getting into the down-stream face, and I do not believe it would be very seriously compacted or that the concrete would weigh as much as it does in the east.

I have made an analysis of material for a dam, using Mr. Hazen's 5702
weights, which are in excess of anything that we would have on this case, of about the following: I consider that there would be 25% in volume, and approximately the same in weight of plums in the concrete. This mixture would be just as rich as the mixture we were talking of yesterday. Then, for 75% of concrete, enclosing 25% of plums, the analysis would be as follows: Cement, $1.60 per barrel at ¾ of the 1.24, .93 of a barrel equals $1.49 for cement. The gravel and sand at the same price, ¾ of the amounts, would be 60 cents per cubic yard. Hauling the same amount times 1¼, which is allowing that my weights were only 80% of the 4,000, by ¾ of the amount, would be $1.20. Bunkering, just the same, 30 cents; forms, just the same, 15 cents; mixing and placing, 75 cents. That is $4.49 for the concrete portion of a cubic yard of concrete. Now, 25% of plums will weigh 1,000 pounds, and would cost in San Mateo considerably less than the sand and gravel, but I have put them in at 40 cents; material at San Mateo, hauling at the same rate, 40 cents, and placing at the same rate, would be 25 cents, making $1.05 for plums, so this makes a yard of concrete, $5.54 in place in the dam at actual cost. This is accepting Mr. Hazen's weights, and all other allowances correspond. There is ¾ of the amount of sand and gravel in that that I assumed yesterday. That was 80 cents a yard, ¾ of a yard. The weight I have not considered until I got to the hauling, and that is 5703
considered as 4000 pounds, the plums being ¼, or approximately 1000 pounds.

Questioned by Mr. Hazen.

There is no rational figure that you can make that will make this cost of concrete seriously greater than here. There is a leeway in all these figures for considerable change in conditions, and the $1.04 which I added yesterday for profit contingencies, etc., would reduce on this analysis to $1.46, so that in that $1.46 there is still plenty of leeway for any allowances whatever that are to be made to suit your conditions. No concrete ever weighed 150 pounds, except with a considerable proportion of plums.

Mr. Hazen: I have weighed a great deal of concrete. The concrete that in our practice weighs fully 150 pounds is concrete without plums; when plums are added it weighs more. The eastern concrete is no heavier than the local concrete. We happen to have some in-
5704 formation as to what concrete weighs out of this particular gravel that you are talking about. These tests were made for another purpose, and are dated November 3, 1915. This report is made by Robert W. Hunt & Co., on 6 x 12 blocks of concrete made from this gravel. These weights were taken in San Francisco from samples of concrete that is being placed at Calaveras at the present time, made from this sand and gravel. The mix makes hardly any difference in the weight a cubic foot; that is a matter of compacting material. The specific gravity of the material is all about the same, and the specific gravity of cement is practically identical with that of sand and gravel, both being 2.65. We think that the compactness of an ordinary block of concrete, which is compacted for the purpose of weighing, is less than
5705 the average compactness of concrete in a structure.

These tests we believe represent less per cubic foot than the actual work, because of the small size of the specimens; they were made for another purpose than to obtain this incidental information from them, but on the richer mix used in the base of the tower at Calaveras the first sample shows 148 and the second sample 143. The poor mix which was used in the facing of the dam, the first sample shows 148, and the second 145½; that is all gravel and sand concrete. The gravel
5706 and sand was obtained from Calaveras Creek. It is not from the same place at Niles that we expect to obtain the sand and gravel for the Crystal Springs Dam, but it is from the bed of the same stream, and I believe it is practically identical material.

The first two samples were about 1—2—4 from the base of the tower, and the second two samples were about 1—3—6 from the facing of the dam. I have here a compilation of the statements of the weights of concrete per cubic foot from the standard books on concrete, which I offer.

5707 (The Master suggested that the compilation be held until after the test is made of the weight of a piece of concrete cut from the Crystal Springs Dam.)

Mr. Dillman: There would be necessary for quick handling of material at San Mateo, a construction of bunkers with an elevated track, so that the dumping would be from ordinary ballast cars, and with bunkers 120 feet long there could be 3 cars spotted at one time. I have put this cost of bunkers at $12,000, which is a fairly high price. It is $100 per lineal foot measured along the track, which includes the cost of the incline, and I have put that at 7½ cents per cubic yard, because there is 160,000 cubic yards of material to handle. The bunkers I have estimated at 3 times that amount at the dam site, or $36,000, making $48,000 in all for the cost of bunkering. This amounts to 30 cents per cubic yard, and was put in as my estimate. I have estimated 15 cents per cubic yard for forms. This would allow considerably more than the outside forms, and if joints were desirable and required in the specifications, they could be put in for that. Mixing and placing 5708
I have put in at $1 a cubic yard. Mr. Lippincott in his figuring on it made $1 include forms, which I have not, but I have considered $1 ample to allow for the mixing equipment, interest and depreciation. In this $1 I have not considered any addition of profit or overhead, so that whatever I add will increase that $1 a corresponding amount. I do not make my equipment charges part of my indirect cost. My equipment is included in this $1 a yard. That is, my mixing equipment, not other equipment. Towers and chutes are one method of handling, but I do not know that I would use them. $1 a yard is enough for handling the material anyway. It would do it without mixers. You could do it by hand almost. The charges for water are included in the $1, and that would include the pumping equipment which is part of the mixing equipment. 5709

The camp equipment is fully taken care of, and often times a great deal more than taken care of by the cook house and commissary profits. I have made an allowance of $1.04 per cubic yard, which allows a considerable profit offsetting the overhead of ordinary estimates where the company does the work. That $1.04 a cubic yard alone is $163,000, and it is ample to cover incidentals, unexpected losses, casualty insurance and profits. Ordinarily for an estimate of this kind a contractor would add 15% for profit, but if he knew he could make 5% he would be willing to do the work. The extra 10% is to cover all contingencies, accidents, incidentals, and this addition is about 18%. I added a dollar, and found that came to $6.86, in getting at my figure, and I added 4 cents to make it even figures. That gives the cost of the concrete in place at the main structure of the Crystal Springs Dam as $6.90.

As an example of the manner in which Mr. Lippincott's 40% for 5710
indirect auxiliary costs would work out in connection with the Crystal Springs Dam, I have taken the items shown on page 20 of this exhibit as applying to the large government dam, and computed the percentage which each of those items bear to the total direct cost of that

government dam, and applied these percentages to Mr. Lippincott's total direct cost of the Crystal Springs Dam. I obtained this direct cost by assuming that his total cost at Crystal Springs was 140% of the direct cost. Testing the dam site on Mr. Lippincott's basis, this would figure $35,340 at Crystal Springs. I have assumed that $7,500 would be ample to cover this item, basing my assumption in part on Mr. Schussler's own estimate as given in his testimony in the last case.

Telephone system: Such of the system as is not all covered in the inventory, and the cost of operating, would not, in my opinion, cost the sum of $2,500 over a period of 3 years.

5711 Road construction: The bulk of the wagon roads are cared for under separate items of the inventory. Even if the haulage were not contracted, and the company took care of the repair and construction of short temporary roads near the dam, and the repairs on all roads, this should not exceed $12,000. That would allow something less than $1,000 per mile per year. The direct charge of hauling would be proportionately less if repairs are allowed on an indirect charge.

Railway construction: As no witnesses in this case have figured on building a railroad into the dam, the item need not be considered.

Power plant: No power plant would be constructed for this work, it being cheaper and easier to buy power direct. The cost of this power should be included in the direct cost of mixing. I would lump all equipment, including the capitalized power cost in the sum of $113,700, which is Mr. Schussler's estimate as given in his testimony in the last case. This makes unnecessary any addition for camp construction, sand and gravel storage, pumping or laboratory, the latter being more properly an overhead charge anyway, and classifiable under engineering. Camp maintenance and heating would be taken care of in the cook house profits. This makes a total of indirect charges applicable to the Crystal Springs Dam, under Mr. Lippincott's theory, of $135,700, or 86 cents per cubic yard, or 14.5% of the direct cost, instead of 40%. If this sum of 86 cents be included with his direct charges, $5.97, his total cost, exclusive of general overhead, would be $6.83 per cubic yard, which would be much nearer the correct figure, in my opinion.

5712 Clearing: At $50 an acre is an estimate from an examination of the country, and the belief that it is ample to cover the cost. The excavation is earth and solid rock. The earth is ordinary plow and scraper work, and the solid rock I have put at $1 a yard, the earth being 25 cents. The clay embankment $1 a yard. The concrete core of the Howard Cut I have increased to $7 a cubic yard, as it is a small amount in comparison to the big dam, and while you would use, probably, the same equipment, you would use it to a little less advantage. The grouted rip-rap I have put at 18 cents a square foot, and the ungrouted rip-rap at 6 cents a square foot. The loose rock 50 cents; top soil 25 cents; clay embankment $1; grouted rip-rap 18 cents;

ungrouted rip-rap 6 cents. The brick I have put at $25 a thousand. Iron in place 4 cents a pound, and the concrete foundation $7.50 a yard. In this last case it is the small quantity that causes me to raise
it 60 cents. The buildings I have estimated at so much per cubic foot 5713
of contents. These are only approximate estimates, and are estimates used by architects. I think they are amply high. I am referring to structure No. 10, structure No. 13, structure No. 14, structure No. 15, and structure No. 16.

Mr. Hazen: Referring to the iron items, estimated by the pound: 5714
It is all flange work, all machined, and pipe of that kind costs 4 cents a pound in all the eastern foundries, freight to be added, and it is expensive work to place. I would not estimate it on eastern work at less than 1 cent for placing, so with 4 cents for material east, and the freight to California, I mean the differential, and 1 cent for placing, would come to about 6½ cents.

Mr. Metcalf: That is all flanged, so I consider that 6½ cents is an absolutely bottom price on it.

Mr. Dillman: The sheet which you have handed me is a compila- 5715
tion from the inventory of my unit prices on these various items of concrete. This takes in other concrete outside of the Crystal Springs Dam. I did not add them up, but I would imagine the average price is about $8. The Crystal Springs Dam is undoubtedly the cheapest concrete per cubic yard that I know of on the Pacific Coast, by reason of its very large volume, and the small amount of forms used.

Sunol Filter Galleries: I generally put that concrete at $8 a
yard. I figured those galleries would be constructed with forms and 5716
poured concrete. I would start at the lower end in reproducing them, and then I would have natural drainage out of my excavation all the time instead of having to pipe water. I would not anticipate any great difficulty in handling the water if I did it that way. This item allows for the cost of the necessary forms, and I assumed that that item of lumber in the inventory included the drainage lagging.

Mr. Hazen: There is no lumber at all listed for the rest of the structure, and there certainly would be quite an item for the rest of the structure; if it were built in this way in a deep trench, some of the lumber would be left, and that is not in the schedule, and in my judgment that would fully balance what is cut off from this item. (Mr. Hazen introduced a statement which was included in his schedule
"Exhibit 111"). 5717

Mr. Dillman: I did not segregate the $8. The material for concrete is very handy, and the forms would cost more than the forms at Crystal Springs, and I put in $8, believing it was ample to cover all costs. I have not made any figures to determine whether the lumber included in the inventory schedule would be sufficient to handle my trench lagging, because I do not know how much of that trench would

have to be lagged. I know that it would not all have to be lagged, and I considered that the item in the estimate for timber in place was sufficient to do that, and estimated it as such instead of putting it into the cost per cubic yard of excavation. There is nothing exact about any of the measurements of these things. The actual cost could be doubled or trebled by inefficient management or carelessness of supervision. It could be increased very easily 50% by onerous specification requirements and inspection. I have assumed that the specifications would not be more than the requirements demanded, and that the execution of the contract would be in efficient hands, and if that were so, there is a profit to the contractor in these prices that I have given. (This table was attached to Mr. Dillman's "Exhibit 113".)

5718 The item of concrete in the tunnels and shaft on the Sunol aqueduct is a concrete lining instead of a brick lining, and I figured that at $10 per cubic yard.

Mr. Hazen: I figured it in all cases into unit price per lineal foot of tunnel excavation.

Mr. Dillman: In Niles Dam the excavation, gravel and boulders, $1 a yard. Excavation for the solid rock at $2 a yard. That extra $1 over the price that I have used on solid rock excavation in the Penin-
5719 sula system would handle a lot of water and stuff; it is a small item anyway.

The backfill I have estimated at 25 cents a cubic yard; the squared stone masonry at $16 a cubic yard; the concrete work at $8 a cubic yard; the reinforcing bars at 4 cents a pound, making a total of $17,561.

Mr. Hazen: My figure on the Niles Dam was $14,926.

5720 The Stone Dam is masonry. It is trimmed with brick. The principal thing about it is that it is very remote, and a hard place to get at; it is in a deep, narrow canyon, a very long haul for the material, and a small piece of work, so that clearing and getting ready is a large item in proportion to the total cost. My figure was $12,268.

Mr. Dillman: I put the clearing at $50 an acre; 10 cents for backfill; 25 cents for excavation of the earth; $1 for the excavation of solid rock; $10 for rubble masonry; $25 a thousand for brick capping; lumber at $40 a thousand; and there is a gate and pipe, $70, and $2.20 a foot.

Mr. Hazen: That excavation is clearing work done in the bottom of a gorge, a hard place to get at, and all the material would have to be handled by hand, and would cost a good deal for that reason. In a similar way it was very hard to get the material, and the stone, sand and cement for the rubble masonry; it is a very long, hard haul; it is a thin arch dam, and the thin section had to be laid up very carefully
5721 and very well, and I should not expect it possible under these conditions to cost less than $18, which I estimated.

Mr. Dillman: There is some showing of rock in that vicinity, and I did not assume that the stone had a long haul; there was a wagon road built down the canyon to it; the excavation could have been started anyway with teams, and it does not seem to show that it was very difficult.

Mr. Hazen: There is no room to work teams; you are right in a gorge, and this excavation is only 15 or 20 feet wide.

Mr. Dillman: That is plenty of room to work teams, and there would be no trouble about that at all. If it is an actual fact that the stone was hauled a long distance, I think my price is low, but if the stone was obtained locally, or within a mile of the dam site, my price is high enough for that kind of masonry. It is a good structure, and the work is well done. I assume that the stone was gotten locally, because in a canyon of that kind you can ordinarily get stone, and there are some showings of granite in that vicinity.

Mr. Hazen: 4 or 5 miles from this dam there is a very poor granite.

Mr. Dillman: That is not a very good granite, but you often work through some friable granite to good quarries. The difference in 5723
this estimate and Mr. Hazen's estimate was that he assumed that the material had to be hauled a long distance, and I have assumed it is very near.

Mr. Hazen: There is a quarry further up that the material might have come from, above the Pilarcitos Dam, but I did not formulate the idea that it necessarily came from that point. I did not see any indications of rock in that immediate neighborhood. I know that there are harder places in that rock once in awhile, and I assumed that it would be exposed in connection with the construction of the Pilarcitos Dam, and that they would get this small quantity from some point where they were otherwise getting rock, other than opening up a special quarry. I do not think the distance of haul of the rock would be the chief item of difference between Mr. Dillman and me. I think he said that. I think the haul on the cement and sand and labor of building and getting rubble masonry of this kind suitable for use in a thin arch dam is quite a large item, and I should not have estimated 5724
it at $10 a yard if the best rock in the world had been available right there. As to what I would estimate it at would depend upon the character of the local quarry as to how much work you had to do on the quarry before you got out that 500 yards.

Mr. Dillman: There is a bank of sand exposed in this same canyon, down below the dam; I do not know just how far, but I have seen it.

Mr. Hazen: I failed to find that. I made inquiries as to it, and I spent a good deal of time walking over that country, and I did not see any sand that could be used.

Mr. Metcalf: I had the same experience. I tramped down into the valley on several occasions, but I did not happen to find this sand.

Dockweiler Witness: J. H. Dockweiler for Defendants.

DIRECT EXAMINATION BY MR. SEARLS.

In reproducing the Crystal Springs Dam, I figured on the iden-
5725 tical structure, using the mixture which was given in Mr. Schussler's testimony in the Farrington case, and it is roughly 1—2—5½ mixture. I incorporated into the dam the total barrels of cement which Mr. Schussler testified went into the dam. I build it in the form of interlocking blocks, and assumed the blocks to have an average content of about 350 cubic yards. After the forms were removed, the sides of the blocks were chipped, and the bottoms also. I made that provision. A washing of a rich cement mortar applied by brushes was then given the sides and the bottom.

Before I made the appraisal of the Crystal Springs Dam, I had before me a report on the dam, prepared by Mr. Schussler, which I received from the Secretary of the Spring Valley Water Co. This report was filed with the Board of Directors of the Spring Valley Water Co. during the year 1887. I also had before me all the detail drawings to the extent that the same were furnished me by the company, at my request, and the inspections that I have made of the structure itself. I examined the photographs that were introduced in the Farrington suit, of the construction and the methods employed. I visited the dam and made an inspection of the structure itself. The
5726 quantities in the dam were measured up by my men who went out there, and we had the drawings and cross-sections from which these quantities were computed. Those were the agreed quantities in the inventory. The drawings themselves, as computed, do not quite give the yardage that we have set forth, but after making allowances, that was the figure agreed upon, using all the information that was obtainable from the records of the company, and statements of the employees of the company.

The table which you have handed me correctly shows my estimate of the cost per cubic yard of reproducing the concrete structure. I wish to state that my total is $6 per yard, while the inventory gives $5.75. The price should be $6.

J. H. Dockweiler's construction data on concrete, Crystal Springs Dam, received in evidence as "Defendants' Exhibit 114".

Materials: I figured the base price for cement delivered at San Mateo $1.86, and I had data before me in estimating this cement price as to the cost of cement under recent purchases made during the years
5727 1907 to 1913. As to the purchases for the Los Angeles aqueduct, this data was obtained from the records of the aqueduct.

Questioned by Mr. McCutchen.

These are purchases that were sent me in response to a request for information concerning purchases of these aqueducts. I did not call for all the purchases between those dates, but just asked that I be sent a memorandum of the purchases of cement. It is not my understanding that these are all the purchases made by the aqueduct between June 4, 1907, and December 14, 1909.

DIRECT EXAMINATION BY MR. SEARLS. 5728

The second sheet shows a few of the purchases of the California State Highway Commission, and the data was secured by N. R. Ellis from the Commission.

The third sheet shows purchases made by the Southern Pacific Co. from the Pacific Portland Cement Co. This data was obtained through Mr. Jerome Newman, now Chief Engineer of the San Fran- 5729
cisco Harbor Commission, formerly assistant engineer to Wm. Hood, Chief Engineer of the Southern Pacific Co. The data was obtained from the records of the Southern Pacific Co.

Mr. Searls: The table states that these prices are net, exclusive of sacks, and f.o.b. at works. I do not know what is taken off for the sacks.

Mr. Dockweiler: I estimated that the loss is 1 sack in 4, but generally they do not lose over 1 sack in 10. I have that in somewhere else.

DIRECT EXAMINATION BY MR. SEARLS.

The next sheet shows the purchases made by the Southern Pacific Co. from the Standard Portland Cement Co., and the authorities of data is the same, obtained from the same source through the same medium. I had also before me the price paid by Mr. Rolandi; in 1912 he purchased cement at $1.45 per barrel f. o. b. San Francisco. The authority for this information is Mr. Robert Long, sales- 5730
man for the Pacific Portland Cement Co.

The City of San Francisco pays $1.40 at the mill for cement used in the Hetch Hetchy Diversion Dam. This data I have from M. M. O'Shaughnessy, City Engineer.

My price at San Mateo was based on an assumed price at San Francisco of $1.57, to which I add freight and warehousing. My price on sand was $1.01 per cubic yard in the bin at San Mateo, and I assumed a price of 60 cents per ton on that at San Mateo. I assumed the sand was coming from Niles. This includes the freight. 5731

I have data as to the price paid for sand by the Southern Pacific Co., which was obtained through the same source from which the other data which I have used came. That was f. o. b. Enwood, on the Sacramento Division of the Southern Pacific Railroad. My sand I buy at Niles, and this is merely data showing what sand can

be purchased for at various places, and shows the reasonableness of a price employed by me.

I assume a price in Niles of 35 cents a ton. The Grant Gravel Co. 35 cents a ton at Pleasanton and Livermore; E. B. & A. L. Stone Co. gave me 35 cents a ton f. o. b. Ocean Shore Railway plant. I have prices f. o. b. cars at points as shown, based on quotations from Grant Gravel Co.; they quoted me that at San Mateo they would deliver it for 60 cents a ton, which is 81 cents a cubic yard. The
5732 Niles Sand & Gravel Co., and the Grant Gravel Co., are at Pleasanton, and the former gave me a quotation of 60 cents at San Mateo per ton, or 81 cents per cubic yard. That quotation was dated March 23, 1914, and was given in the nature of an interview. That is for material fit for incorporating into a dam. I explained what I wanted it for, and the probable amount, and that it was to be the washed and screened product. Mr. Ford gave me this information, and the prices quoted are certainly justified by what other folks have paid for sand.

Questioned by Mr. McCutchen.

5733 I do not know what that Enwood sand was used for, but I presume it was used for concrete.

DIRECT EXAMINATION BY MR. SEARLS.

I figured 97 cents a yard as the cost of hauling the sand from San Mateo to the Crystal Springs Dam; $1.98 per cubic yard delivered in a conveyor bin at the foot of the knoll where the sand was to be taken out by the conveyor. That is at the rate of 67 cents a cubic yard of concrete for the sand employed in the mixture.

5734 My cement cost $1.86 for warehousing, freight to San Mateo, and lost sacks. Hauling to the dam per barrel is 24 cents; cost per barrel delivered at the dam, $2.10. 1.24 barrels of cement required for 1 yard of concrete equals $2.61 for the cement employed in mixing 1 yard of concrete.

Motor truck hauling: I obtained the cost of trucks, and interviewed the various contractors engaged in motor truck hauling, and prepared from memoranda, and from that I deduced the cost of hauling this material. My figure for this cement hauled to the Crystal Springs Dam—a 4-mile haul—was 30 cents a ton mile, which included the cost of road maintenance. There are 8 miles traveled, and under my computation there are 24 cents allowed for each round trip that an auto makes between San Mateo and the Crystal Springs Dam. I made the distance 4 miles from the depot to the top of that knoll where the material is to be delivered.

Crushed rock: I figured on getting that from the old quarry which was employed in the construction of the dam. This quarry
5735 is located on the easterly side of the Crystal Springs Reservoir, half

a mile north of the dam. The estimate for getting that rock out and delivering it to the bins was made by Mr. English, and I worked along with him. The rock is to be delivered into bins on the side of the existing road, and from these bins loaded by gravity into auto trucks. The estimated cost of the rock in the bins is 75 cents a cubic yard. I allowed 27 cents for hauling it from the quarry to the dam, and that makes my rock $1.02 a yard delivered. I figure that I would use 1.02 yards of rock per cubic yard of concrete, so that will make the cost of the rock per cubic yard of concrete $1.04.

The material weighs to the cubic yard, without water, dry, about 3,966 pounds. You have got to add water to that so as to get it in place, and I should say roughly, by adding 50 pounds more that about 4,015 would be the weight of a cubic yard of concrete in that dam. I state that from this experience in a way; I was assistant engineer in the construction of the Los Angeles cable railway, and we built an incline of concrete, running on a high steel trestle, and years afterwards we had occasion to break that up. In breaking it, we found the center of the mass a steel blue, and very damp; in other words, it never dries out. I never had a chance to weigh it, but I know that the interior of the concrete does not dry out; there is always water there, and it will stay to the end of time. This structure was only about 20 feet wide, and at about a foot in it was steel blue and moist. 5736

Questioned by Master. 5737

In my item of the cost of sand per cubic yard in bins, San Mateo, the $1.01 includes the cost of the bins.

DIRECT EXAMINATION BY MR. SEARLS.

In figuring the mixing and pouring of the concrete, I employed the system which was outlined by Mr. English in his testimony. I employed Mr. English to prepare an estimate of the cost of quarrying the rock, which included the installation of the plant, and all incidentals in connection therewith, with the instruction to have the material delivered in bins on the side of the road, so that the material could be loaded by gravity from the bins. I further directed that he prepare a study of the equipment, determining its nature and cost for the purpose of mixing and placing the concrete. My idea in asking him to do that, instead of doing it myself, was that he is a specialist in that matter, and as I had never poured any concrete on a dam of this size, and as there had been a great many improvements in the past ten or twelve years, and being conscious of the fact that he was equipped by experience to do that work, I 5738
selected him to make these studies.

He prepared the lay-out of the plant. I went over and verified those figures, checking them; wherever he used lumber, I gave him the price delivered. He did not make any inquiry on the costs of

the lumber; that was given him by me. Every stage in the proceeding was gone over by him with me. He explained the various operations, and I asked him his reasons why he did so and so, and especially asking him about his output. Before that I also had studies made for me of an equipment somewhat similar to the equipment he ultimately worked out. In preparing the estimate which appears in the inventory, I did not accept Mr. English's figures as to the cost of pouring and mixing, without any changes. I suggested to him the raising of his price for pouring. He had a smaller
5739 price, and after talking it over, he agreed with me on the raising of his price.

The figure $6, which is 25 cents a yard higher than the unit price which appears in my inventory, I raised on profit. I made my profit 76 cents instead of 50 odd cents that I had before. The item of liability insurance, 3 cents, was jointly determined by Mr. English and me. My information was this: The present liability law, which he took at about 7½ cents for concrete men, those rates did not apply as between 1907 and 1913. From the best study I could make, I thought the 3 cents per cubic yard was about the rate which was proper. That would be an average rate to cover that payroll
5740 during those times by insurance companies. That was the judgment formed by me then on the best studies I could get. I talked it over with Mr. English when we made the estimate together, and he said, "Well, that is right, then, I was thinking of 7½ cents." This was made in 1914.

I have every reason to believe that the photograph you are showing me indicates a method of constructing the Gibralter Dam at Santa Barbara. This was sent me by Bent Bros., the contractors.
5741 The tower shown in that drawing is on the side of the dam, and I should judge about the center of it, while the tower we propose is
5742 at the end of the dam opposite the center.

Photograph showing flexible pipe received in evidence as "Defendants' Exhibit 115".

My figure as to the cost of mixing and placing, including the forms, depends upon the estimate made by Mr. English, which estimate I checked, and found apparently reasonable. I agreed to the figure of 7 cents per cubic yard for field overhead, supervision, and office expenses, because I checked it, but I do not think I have used the words "field overhead" in my notes. I say "Time-keeper, clerk hire, office expense, etc., field". It is the same item that Mr. English calls field overhead, supervising, office expense. That is not intended to include any part of the general engineering expenses, or home office administration charges. I interpret that, and intend it to cover the following: A clerk and two time-keepers, auto rental for a runabout, telephone, office building, and material building. I as-
5743 sume a camp to be self-sustaining. In a situation of that kind, which

is most favorable, 4 miles from San Mateo, that assumption in my opinion is fully justified.

Profits and contingencies 76 cents; that is what I think would be a fair profit for doing that work. It is an arbitrary figure. The contingencies item includes something unforeseen. It is anything I have not covered. It is not a contingency which relates to a contingency which a man introduces in preparing an estimate, and which cover uncertainties as to the nature of the material, and as to difficulties, or uncertainties of methods of operation; it does not apply to that, because there is no uncertainty on that score. It would cover anything that I may have omitted.

If you are going to do something de novo which has not been done, you are justified, dependent upon the nature of the work, in applying a very large percentage. I can instance that: I am now preparing a study for a water supply for the City of Richmond. I have in that a study for a three-mile submarine pipe; I have studies on tunnels and on reservoirs. I expect to allow a very large percentage in that estimate to cover uncertainties and contingencies. 5744

Questioned by Mr. Greene.

I have not determined on how large a percentage, but it is going to be a good, safe, and large estimate. On my submarine pipe the Government will require that you dredge a trench 6 feet deep. I cannot lay the pipe the way the submarine pipe is laid across the Bay of San Francisco by the Spring Valley Water Co. The regulations now require you to dredge a trench 6 feet deep, and to lay the pipe in the trench. It is a navigable stream, and boats pass up and down. All of those conditions justify me in adding a good, stiff sum. In the tunnel work, the Franklin Canyon Tunnel being close by, and which gave a great deal of trouble in driving it, not knowing the exact difficulties encountered in that tunneling, I am going to allow a good, stiff percentage to cover such contingencies. The less information you have, the greater percentage you add; where you have everything definite, you are not justified in so high a percentage.

DIRECT EXAMINATION BY MR. SEARLS.

An allowance for waste materials is included in figuring the quantities which are agreed upon in this inventory. For instance, Mr. Schussler's testimony shows how many thousand barrels of cement went in; that is every barrel of cement the company purchased, and includes the waste, and so you have automatically allowed it. I allow 2% for my waste and rock. Mr. Metcalf and I, through correspondence, cited Mr. Schussler's testimony, and de- 5745
termined upon a mixture; dividing the total barrels given by Mr. Schussler by the yardage, we arrived at 1.24 barrels per cubic yard employed. I am referring only to the Crystal Springs Dam.

This item of 76 cents does not include any wastage of materials. The possible damage by water is very slight, for the reason that this is a concrete structure, and it cannot possibly hurt it to have the water pass over it. My plan for construction proposes the construction of the long tunnel through the dam, and that tunnel I propose to have open, and it will dispose of my water during construction, whatever there is to be disposed of, so I am not confronted with the ordinary difficulties. The only risk I would run would be that incident to the excavation of the deep trench. I propose building during the summer time. Having driven my tunnel through the hill, all I need to do is to put up a little barricade to take care of the waters which flow during the summer time, and while I am dig-
5746 ging my trench, fill it up with concrete to the floor of the valley; then I expect to abandon the work in the winter season, and commence again in the spring, so that the damage from water is almost negligable.

The loss of, or injury to cement in transportation, or any trouble that might occur after the cement had reached the dam site, is automatically taken care of. Mr. Schussler's method of handling that included all the material that was charged to the dam. If you lose any, then your mixture is just that much poorer. In other words, if you lose 100 barrels, that 100 barrels did not get in, but it is estimated in our mix. My impression is it would take over two years to build this dam, and my figures make allowance for lay-offs due to climatic conditions.

Questioned by Mr. Greene.

I have no segregation in my mind of the 76 cents as between
5747 profits and contingencies. I did not attempt to make an estimate of the profit, but the contingencies in this estimate are very, very small. Even if a man got 60 cents, I would consider that a good profit, because there are 157,000 cubic yards in the dam; at 60 cents you would have a $100,000 profit. I am assuming in my overhead allowance that the company has a purchasing agent, and that backed with its immense purchasing power, he, at the figure I have given, will be able to go into the market and get for his company the best bargain that is available. I have assumed that a man skilled in the profession of purchasing will be employed; the contractor does not have to put up his money. He has not his money tied up in the purchase of cement.

Questioned by Master.

The company having the credit buys the material, and notifies the contractor that it will be ready for him. The company makes the purchases as he is ready to handle the material, and that system
5748 I have pursued throughout my reproduction theory. The other scheme is this; your credit is A-1, then you hire a contractor who

makes a purchase, and on that purchase which you could get for the same figure, you pay him a profit. It is not business.

Mr. Searls: I happen to know that in the high fire pressure system the City bought the pipe, and also in the Hetch Hetchy construction. I believe in the case of the Geary Street Railroad, the City did not furnish the cement.

Mr. Dockweiler: Clearing; that is for 1300 acres, and on that 5749
I used $40 an acre, which is the same price that I applied at Pilarcitos. The next is excavation, top soil 22 cents. I could remove that by plows and Fresnos. The haul is only 200 feet. On the rock excavations I have used the figure of $.88. I divided this into various classes. There are 3,000 yards of it in the lowest part of the trench at $2.50 a yard; then the next layer, higher up, that is at a less depth, 4,500 yards at $2; the next is 10,000 yards at $1.50 a yard. The top-most layer is 7,520 yards at $1. That gives a total of
$39,020 for 25,000 yards. Mr. Schussler estimates that the expenses 5750
of prospecting and stripping his dam site were $8,000. I add that $8,000 to the $39,000, and it makes a total of $47,020, which I divide by the 25,000 cubic yards, and that gives me an average price of $1.88. That was an estimate that Mr. Schussler made of the cost, and I know that his reproduction estimate in 1904 was 20% higher than the cost. I know it, because I have checked his estimate with figures where I have known the costs.

In my cost of solid rock excavation I have included the cost of all the prospecting and tunneling; part of this tunnel is incorporated in this very dam core itself, and it is measured again as excavation, so I am adding this $8,000 to a sum which fixes a price that includes
the yardage removed from the tunnels. 5751

Howard Cut: The excavation there is 26 cents, and I remove that by plows and scrapers. The difference in the excavation cost there, and in the reservoir proper, is explained by your 300 foot haul there. That trench is 12 feet wide, and varying from a few feet to 70 feet in depth, and I have used the price of $2.50 on my rock excavation.

You could haul your rock from the quarry even while the 5752
Howard Cut was being excavated. I have the cross-section of the Howard Cut embankment, taken from data furnished me by the company, and it shows that the original surface was as indicated by the contours, that it was a saddle or depression, and not a ravine or gorge, and hence it was an easy matter to haul. There were no difficulties at all. I used a steam shovel on this Howard Cut embankment. I allowed 2 cents for getting it on the job, 3½ cents for stripping the pit, 8.9 cents for loading, 40 cents for hauling, 8.9 cents for spreading, and I add 10 cents for pumping water. That gives me 64.3 cents, to which I add 25%, which amounts to 16 cents, making a total of 80 cents. It was quite a distance away where this ma-

terial was obtained, hence my high cost of hauling. There was a saddle there, otherwise you would not have any trench. The trench goes down below the foundation of the clay embankment in order to give the soil the strength to withstand the water pressure, but that does not obviate the fact that there was material there from
5753 which you excavated the trench, otherwise there would be no trench; hence there must have been a saddle there.

Price per pound of cast-iron pipe: I have 4.9 cents. 81,500 pounds at 4.9 cents per pound. This weight of pipe comprises 27 pieces of the 50 inch diameter pipe, cast-iron. The pipe is on the inside of the large circular gate house. I sent a photostat of the drawing of the pipe, and received a quotation from the Warren
5754 Foundry Co., on June 6, 1914, for $2\frac{7}{8}$ to $5\frac{1}{8}$ cents a pound. I went to the local agent representing the company, Mr. Blair, and furnished him with a drawing, and stated that I wished a quotation on the materials of the various classes set forth in the drawing. This is the drawing from which the pipe were originally built, and was forwarded to the main office of the company, and this letter is the response from that office.

That amounts to $57.50 per ton. Railroad freight San Francisco to San Mateo $1 per ton. Hauling, San Mateo to the dam, 4 miles, $3.50 a ton. Erection $33 a ton. I add $3 to that, which gives
5755 me a total of $98 per ton, or 4.9 cents per pound. The same people gave me a quotation for all the bolts, heads and nuts, at $66 f. o. b. San Francisco. I worked that out to 3.79 cents, which I rounded off to 4 cents a pound.

Mr. Hazen: I bought flange pipe from the Warren frequently, and I have never bought it for less than 4 cents a pound.

5756 Questioned by Mr. Greene.

I interviewed the agent here, and told him that I wanted first-class work. I furnished him with the drawings. I purposely blotted out every reference as to the place where it was to be used. That was the price as of June, 1914.

DIRECT EXAMINATION BY MR. SEARLS.

Gate tower and standpipe: That is 1,010 cubic yards at $3 per yard. The 1,010 cubic yards represent the excavation of a shaft which is 92 feet deep in solid rock; from the bottom of this shaft the main outlet tunnel leads through the hill, and leading into this shaft are three tunnels at different elevations. This shaft would be built by driving your lower tunnel first, and working up to where you have reached the bottom of your shaft, and then running an upraise, and having your material drop down, and not hoisted up the way some of the engineers have assumed it to be built. You drive each tunnel into the shaft, and then break down and have the ma-

terial fall to you. You can do that very cheaply. I have done engineering work of that kind, and I think I know how to economically 5757
attack the proposition.

I assumed that these 865 cubic yards can be picked and gadded, and dropped into the 4½ x 6 foot shaft from the bottom of which it will be carried out through the main outlet tunnel. I first run an upraise in the center. I run a hole right through the center of this big shaft which is 19½ feet across. Having the hole in the center of it, the men just loosen this material and shovel it into the center, and it drops down on to a plate below, and you load it into a car, and cart it right out. It is the cheapest possible method of constructing it. I take the following: 6 miners for excavation of main shaft at \$3; 2 muckers at \$2.50; then I take half of a blacksmith at 5758
\$1.75, and half of a helper at \$2.75, which makes \$1.38, and a half of a foreman at \$2; then I take the smithy tools, \$1, giving me \$30 as the cost for 15 cubic yards. The reason I take half a blacksmith, half a helper and half a foreman, is as follows: While you are sinking this shaft, you are driving your long tunnel, and I charge the blacksmith off to the two operations. I have charged one-half on the long tunnel work, and the other half to the crews in the shaft. Then I add 25% ; that gives me a total of \$37.66, and dividing that by 15 it gives me \$2.50 a cubic yard for that operation. In driving this shaft through the center I have 145 cubic yards, which costs me \$6 a cubic yard, so the total of that is \$3,041, and dividing that by 1,010 cubic yards, it gives \$3 a yard for the entire shaft.

I have had experience in handling mine shaft work. I have 5759
sunk shafts in hard rock. I think, in view of my experience, that \$3 a cubic yard is a reasonable figure for the way this shaft could be worked. If you had to raise all your material, and had no outlet from the bottom, the cost would be materially increased.

Questioned by Mr. McCutchen.

The size of the shaft was 19 feet in diameter, and 92 feet high.

DIRECT EXAMINATION BY MR. SEARLS.

My correction in the cost of concrete does not extend to any other items than the concrete in the Crystal Springs Dam and the Howard Cut. I selected those two items because it was such a large 5760
job, and would be handled by machinery and appliances which I did not assume would be handled on any other part of the work, and not having any familiarity with the appliances, I deemed it expedient to employ a man who was so equipped. As to the other methods, though, I am fully conversant with the method of handling the concrete. I figured on all these jobs independently, so if I change my figures in one of them, it does not necessarily affect the others. The reason for adding the 25 cents on one job, and not on the others, is just a question of judgment. There also might be a liability of some

of these pouring devices being patented, and to allow for a royalty I wanted to include that, and to be safe.

The Sunol Filter Galleries: I used, in making this estimate.
5761 Plan F-268. That is the Spring Valley reference. In constructing those galleries, I would start in at the lower end and work up, and would handle my water by means of a pipe. You would have a mixture of concrete, and would wheel it in with buggies, which would increase your cost somewhat over the Crystal Springs method. The reason for my increase in the price of concrete is due principally to the method of handling. The freight rates would also be different; the sand would be obtained at Niles, and the labor on that is $1.15 a yard. My material costs me $4.73 per cubic yard, and I allow 18 cents for water and tools. I have no quantity here for timbering. I say "included in unit cost of excavation". I have plow and scraper work 18 cents a yard; I have excavation, pick and shovel, 10,721 cubic yards at $1.40 a yard.

5762 Niles Dam: I used $8.75 a yard for that stone masonry, and my labor charge there was $5.12 a yard. I estimated that the cost of laying, gathering and preparing the stone, is $5.12 a yard; the plant cost is $1.11; mortar necessary for the stone $2.29. I made a charge for water. The total is $8.62, which I rounded off to $8.75. The stone is ready there in the bed of the stream. The sand cost me $1.87 at Niles. The haul is 1 mile. That cost me $2.02 a barrel for the cement. The sand you will find in the bed of the creek at Niles. I assumed that you would get the sand from that creek.

Stone Dam, Pilarcitos Canyon: There is an outcrop of granite
5763 about 150 feet above the dam; the stone was obtained from this point, and there is practically no quarrying necessary to get it out; it is right on the side of the hill. There is also granite below the dam. I figure that my cement will cost me there $2.31 a barrel, and the sand $3.73 a yard. I add lime to my mortar to facilitate its working. My cost of mortar per cubic yard is $12.17.

Questioned by Mr. Hazen.

You don't use much lime in mixing your cement mortar. You use just a little bit to smooth it and make it work easy. This is an added cost. If you don't use it, I would save just that much.

DIRECT EXAMINATION BY MR. SEARLS.

The cost of getting the stone and laying it is $5.60. One-third of a cubic yard of mortar is $4.06, to which I add $1.40, and it rounds out my price to $11. There are 593 yards of broken range masonry at $11.

5764 Mr. Hazen: The concrete dam at San Mateo is a remarkably good little arch dam in a gorge; it is not as far away as the Pilarcitos Stone Dam, but it is quite removed and a difficult place to get at. It is a small piece of work. It is of much more recent con-

struction, and is concrete, instead of the rubbel used in the Pilarcitos Stone Dam. My price is $15 a yard.

Mr. Dockweiler: It contains 815 cubic yards, and my price is $8.50 a yard.

Questioned by Mr. McCutchen.

I hauled my cement in there. The road goes up very close to the point where it is used; it is a steep road. My impression is there was an old road that came down the ravine, and the road that you go in now stops some little distance near where the flume, or the Stone Dam aqueduct trestle crosses. There is no road there now, 5765
but that is how you would get your material in. Perhaps you would have to skid it a little, but not much. I cannot recollect any specific allowance for putting the road back in condition.

Mr. Hazen: Referring to the $15, I think that is as cheap as a structure of that kind can be built in that location. The forms are expensive; the structure is light, the sides are curved, the carpenter work is considerable; there is a great deal of preparation work, and it is a very hard place to deliver materials. I should not expect to build it for less than $15. That is $6 more than my allowance at Crystal Springs Dam, and I should think there was fully that relative 5766
difference.

Sunol Filter Galleries: That is excavation, pick and shovel, 5771
gravel, 10,721 cubic yards at $1.40. This trench is 2,480 feet long, and it averages 7½ feet by 11 feet deep. Timbering on this is 71 cents a cubic yard. The excavation is 63 cents; allow for working water 5 cents; that runs it up to $1.38, which I called $1.40 per cubic yard. I have included the cost of the timbering in my excavation.

EIGHTIETH HEARING. DECEMBER 15, 1915.

Witnesses: J. H. Dockweiler for Defendants.
W. A. Bechtel for Defendants.
Jerome Newman for Defendants.
Geo. R. Gay for Plaintiff.
S. P. Eastman for Plaintiff.
Allen Hazen for Plaintiff.

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Hazen: I find I did not state as to flange pipe quite accu- 5772
rately. I took that at 5 cents f.o.b. San Francisco, and added 1½ cents for getting it out there and laying it. It is rather a hard place to lay.

Mr. Dockweiler: My price for flange pipe in place ranged from 4.9 cents per pound to 7.15 cents per pound. The 4.9 cents per pound is for the straight pipe, and the 7.15 cents per pound is for the flange pipe and specials.

(Certain corrections noted in the record.)

5773 Mr. Hazen: I do not think that I outlined any specific method by which I built the Crystal Springs Dam. My point of view on that is to draw the plans and specifications of what was wanted, and in a way to permit it to be built as economically as might be. In our work we call for bids, and the bidders build it as they see fit; different bidders have different ideas, and we cannot attempt to limit them to any system; whatever system is selected by the successful bidder for carrying it out is used. I had in mind in a general way the possibility of the use of all the systems that are in common use for handling material, without division between them. I can tell you the methods that have been actually used in that particular dam to some extent. I have not prepared, myself, a minute extended description of that kind, but in a general way I am quite familiar with the methods that have been followed on quite a number of recent large dams.

DIRECT EXAMINATION BY MR. SEARLS.

5774 Sunol Filter Galleries: A concrete in place gallery, 2,188.9 cubic yards; the length of this work is 2,483 feet, requiring 9/10ths of a cubic yard per lineal foot. I figured 67 cents per cubic yard of concrete for the lumber, which includes the labor on the forms. Mixing and pouring is $1.15. The rental of the mixer is 8 cents. Getting the mixer on and off the job 2 cents a yard. Concrete materials, 1 mile haul, $4.73; that covers both materials and haul. I then allowed 17 cents for extra drainage. My base price of cement delivered at Sunol
5775 is $1.87. I assumed a 1 mile haul for the sand and gravel. I made my mixture with a 1 mile haul, using 1.24 barrels of cement, .34 yards of sand, 1.2 yards of gravel, giving me $4.73 per yard of concrete for material hauled 1 mile. For 1 mile haul, 1.24 barrels of cement $2.50; .34 yards of sand 54 cents; gravel 1.2 cubic yards $1.69. That rounds out to $4.73. That is the amount of material required to form 1 cubic yard; that is the cost of the various materials necessary to form 1 cubic yard.

5775-5778 (Discussion between Counsel and Master as to the admissibility of Mr. Schussler's testimony in the last case.)

Mr. Dockweiler: I made a comparison of the cost of pouring concrete, taking the contract prices for which contractors are doing the work of laying concrete on public highways, with my figures for placing concrete in the Crystal Springs Dam. I obtained my information as to the contract prices on the State Highway from the State Highway
5779 Commission, in the Rialto Building, in this city. I also obtained the specifications for those contracts.

The work on the State Highway is the same mixture as was used in the Crystal Springs Dam. The finished concrete weighs in the neighborhood of about 4,000 pounds per cubic yard. The work of the State Highway consists in the laying of a concrete slab or base upon which

the asphalt is placed, which is about 4 inches thick, and about 15 feet wide. The State furnishes f.o.b. to the contractor, at the nearest railroad station, the cement, sand and compressed rock. The average haul of these materials is about 2 miles. On a parity, and applying similar figures, assuming that the broken rock has to be loaded from the cars into auto trucks, and that the sand is loaded into the bins, and then put into auto trucks; I refer to the Clark & Henry contract of April 5780
23, 1913, for that section of the San Mateo County Highway, which 5781
lies between Oak Grove Drive and Belleview Avenue, for laying 421 cubic yards of the concrete for pavement base, they received $3 a cubic yard. The State furnished the materials, the contractor hauled them 2 miles.

Flynn and Tracy, on April 23, 1913, were awarded a contract on the State Highway for the north boundary of San Mateo County to the south limits of Daly City; this was for 2,140 cubic yards of concrete work, and they received $1.75 a yard.

Questioned by Mr. Greene.

Their contract covered 2,140 yards of material. I do not know the length of their haul, but the $1.75, in my opinion, is too low a price. For a comparison I have assumed $3 per yard, which the contractor received from the State for doing this work. On the basis which I have used for my Crystal Springs Dam, assuming that the rock is to be loaded by hand, I estimate that it would cost, with profits to the contractor for hauling, the sum of $1.61 per cubic yard for the material delivered at the mixer at the side of the work. That leaves $1.39. The material is the sand, cement, broken stone or crushed rock. That includes the unloading from the cars, the hauling, and the unloading at the site so as to deliver it to the mixer. It does not include 5782
the cost of the material, as the State furnishes that free. A contractor receiving $3, according to my estimate, has $1.39 left with which to perform all of these operations, and that must include his profits. As a comparison, for the same operation on the Crystal Springs Dam, my figure is $1.68, in which case the material is delivered, so that I figure $1.68 for the Crystal Springs work, and $1.39 for the Highway work.

DIRECT EXAMINATION BY MR. SEARLS.

In the first place, the mixing plant, in addition to being a very small one, was continually being moved, and the materials are placed in the mixers by barrels loaded by hand. The material is delivered into place by means of a spout from the mixer, is spread and tamped by hand, and the surface must be shaped to a given curve and smoothly finished. The concrete surface is kept wet for ten days by checking the surface by means of checks or basins filled with water, formed by placing dirt levees about 6 to 8 inches high along the side of the work, and across the roadway, the length of the check being dependent upon the grade of the roadway. If it is very steep, the checks are

close together; if it is comparatively flat, the divisions lengthwise of the road are much larger. The contractor has to do this on that balance; out of the $1.39 he has to meet the cost of mixing and depositing the concrete; he has to handle the surface of the concrete so as to have it conform to the crown of the cross-section of the road. He has to tamp that concrete, and to finish and smooth the surface. The
5783 finished concrete must be kept moist so as to properly cure it. He must set his forms to line and grade. He has to maintain lanterns and barricades so as to protect both the work and the public, and this requires a watchman. The contractor has to pay his compensation and liability insurance, and the men work only 8 hours a day. He must install a pipe line along the work in order to supply himself with water, and in most cases he installs a pump to furnish water under pressure, so as to obtain water quickly to avoid delaying his mixer. In some cases he has sunk wells. He furnishes all equipment and tools, and therefore stands all depreciation. He furnishes all the lumber for the forms, and maintains an office; he provides clerks, time-keepers, telephone calls, etc. He furnishes his auto as a means of transportation, and he is responsible for all materials lost or damaged through his fault, and after he has done all of this, he still has a profit.

Questioned by Master.

The haul from the point where the State furnished the material I figured at 2 miles, and $1.61 for the cost of all the material. That leaves $1.39 for him to perform all the work after the material has
5784 reached the site of the dam. I would compare the $1.39 with Mr. Hazen's figure of $3.98, and with my figure of $1.68.

DIRECT EXAMINATION BY MR. SEARLS.

Now, for comparison, the concrete at the Crystal Springs Dam is one large mass of 157,000 cubic yards, which is all mixed at one spot; all the materials are handled by machinery, hand labor being used only for tamping, treating the blocks or brushing them with cement, and sprinkling the concrete with a hose. The outside or permanent forms during the construction of the dam enclosed the entire mass, which, at its greatest width at the bottom is 175 feet, and 42 feet wide on the top. The interior of that mass is divided off into blocks by movable forms enclosing about 350 cubic yards. It is obvious that for the permanent forms for the same height of dam these would be practically the same, irrespective of whether this dam is 1 foot thick or 200
5785 feet thick. The inside forming is the variable, dependent upon the thickness, so that for the outside forms, and unit costs per unit yard varies in the direct ratio of the volume of the enclosed mass. In other words, if 1,000 feet of board measure comprises the forms, and the material is 10 feet thick, that 1,000 feet of material would enclose the same mass if it was 50 feet thick per unit. In other words, if the sides of a room are of a given height and length, if the room

was 10 feet wide, there is a certain volume; if the room is 40 feet wide there is another volume between the sides. Now, for inside or movable forms the cost per cubic yard depends in this case upon the number of times a given amount of form lumber is used over again.

The fabrication of the concrete on the Highway is extraordinarily good work, and the concrete weighs practically the same as the Crystal Springs concrete, and it is done most carefully. The Highway work is more expensive than the concrete at Crystal Springs Dam according to my way of thinking.

Witness: W. A. Bechtel for Defendants. Bechtel

DIRECT EXAMINATION BY MR. SEARLS. 5786

I reside in Oakland, California, and am a contractor by occupation, doing general contracting, and in conjunction with that work I handle 6 motor trucks. I have been handling them 2 or 3 years, and am familiar with the cost of operating and maintaining them. I have occasion to haul material such as cement, sand and gravel. At your 5787
request I went over the road from San Mateo to Crystal Springs Dam, including the portion of the road which leads up to the north side of the crest of the dam. During this trip I inspected the grade and character of the road, and particularly the last portion leading up to the dam. I am familiar with the ordinary contract prices which are paid for hauling materials over roads of that class. I have been using motor trucks since 1913, and I think it was in 1912 when they were first generally used in country transportation. I believe I knew the prices that were obtained for hauling over roads of that character generally in 1913. Those prices were about the same as the prices that 5788
are obtained today. If anything, they were lower.

(The following answer was permitted to go in subject to an objection by Counsel.)

If I were to assume that a contract were to be let for hauling the sand and cement necessary for the construction of 157,000 cubic yards of concrete, which means about 250,000 tons of material to be hauled 4 miles over the road from San Mateo to Crystal Springs, making a total of 1,000,000 ton miles, and if I were to further assume that the road was a good macadam road, and that the contractor would have to stand the cost of road repair, and also that convenient loading facilities, that is that the sand and gravel would be automatically loaded 5789
from bins, and the cement to be loaded by hand from the cement house, I would have estimated 20 cents per ton mile as a fair price in 1913 for hauling.

The roads over which I have been hauling around the bay cities are not materially different in the character of the surface or the grade

from this road which I have just visited. It would be possible to use trailers in hauling over this road from San Mateo to the foot of the
5790 grade about half a mile distant from the dam. I believe you could use small trailers to go up the grade.

CROSS EXAMINATION BY MR. GREENE.

I have been going on the assumption that this hauling would continue 2 years, that is through 2 winters. The road repair would probably be $10 or $15 a day. You can assume a cost there of from $7,000 to $10,000. I base that figure on passing bids.

I have done considerable road repairing myself. It was over roads from the Eel River Canyon. I have been doing road work and railroad construction work for 17 years continuously. The material here is easier than the repair road work I had on the Eel River. I have assumed that the road would be a macadam road, and it would not make any particular difference to me whether it was water or oil filled,
5791 as far as the cost of repair went. It would in the repair work, certainly, make a difference whether it was one or the other. In my figure of $7,000 or $10,000 I assumed water.

In one contract I had 150,000 ton miles over a distance of 50 miles of road that run with curvatures up to 40 degrees, and 20% grades. These roads I had to keep in repair. I have never done any contract hauling in San Mateo. I never had occasion to examine the road from San Mateo out to Crystal Springs Dam, excepting the one
5792 day that I went up there.

I do not know that I would make an allowance in cents per ton mile for road maintenance. I would put that in an additional percentage to cover all outside costs. It would not be taken into the cost of operating the trucks. I would add 10 to 15 percent for outside costs. The figure that I have given you of 20 cents is a profit. I did not figure the cost when I told you 20 cents a ton mile. I wouldn't say over 1/3 of a cent per ton mile for road repair. For the purpose of figuring the cost of this, I have figured 2 years to wear the trucks out, and 7
5793 to 8 trucks would be needed. The equipment I use would cost about $6,500, or a total of $45,000. I probably would have a repair shop at San Mateo which would represent an investment of $500 or $600. That would more than cover the cost of the shop, and of the ground, and whatever building I needed. I would require probably 20 feet square in the building, as any extraordinary shop work I would expect to
5794 bring to a shop in San Francisco. The building would be of galvanized iron, and the ground I would rent for a nominal sum; I do not know how much they would ask for it.

I would allow, I suppose, for road repair tools, a half dozen shovels, some wheelbarrows and a wagon; I presume about $50 would cover this. If a machine broke at the other end, I would take it in with some of the rest of them to the shop, and there would be no

necessity for keeping it under cover, aside from this one shop, as I would keep them at work all night and all day. 5795

I would have a driver and a swamper for each machine, and would pay $5 for the driver, and $2.50 a day for a swamper. They are to work 10 hours a day, with 2 shifts The other 4 hours there would be a mechanic looking over the machines. You could have a driver and a swamper each shift each machine; that would mean 14 drivers and 14 swampers whom I would expect to pay during that period. There would also be a mechanic at the garage, possibly 2, but I would expect to run it with one, and I would pay him $5 a day. He would 5796
have the assistance of the driver. There would have to be a timekeeper at $60 a month and his board, and I would be there myself. The men on the night shift would be paid the same as those on the day shift. Under my plan I did not necessarily work all the time. When the work is suspended I do not pay them, but I endeavor to keep them busy continuously.

With these 7 trucks, my estimated daily delivery at Crystal 5797
Springs was about a minimum of 250 ton miles per ten hours.

Witness: Jerome Newman for Defendants. Newman

DIRECT EXAMINATION BY MR. SEARLS. 5798

I reside in San Francisco, and am 53 years of age. I am a civil engineer, and have been engaged in that occupation since 1887. At the present time I am Chief Engineer of the Board of State Harbor Commissioners. I graduated from the University of California in 1883, after that taking a post-graduate course in Berlin, at the Polytechnic School until 1886.

My work up to 3 years ago was entirely in railroad construction, both in the field and in the office. In connection with that I did some concrete work, both in the way of designing and some small amount in the way of actual construction in the field. As Chief Engineer of the Board of State Harbor Commissioners I have been in direct personal charge of the construction of 6 reinforced concrete piers containing approximately 250,000 yards of reinforced concrete, a 15 foot concrete lined tunnel under Fort Mason, a reinforced concrete roundhouse, and various smaller structures.

Prior to the time I came with the State Harbor Commission, I worked for the Northern Pacific, Southern Pacific, Atchison, Topeka & Santa Fe, and the San Pedro, Los Angeles & Salt Lake Railroad. 5799

My work with the Southern Pacific was principally in the office, as personal office assistant to the Chief Engineer, Mr. Hood. I had access to the cost records, and for 6 or 7 years was in charge of the preparation of these cost records. I made estimates for all new work, which included estimates on concrete work. I had field work with the Northern Pacific, and the Atchison, Topeka & Santa Fe. After

the design was made, I would go into the field and watch the carrying out of the plans, and keep cost records.

I have been in personal charge of the concrete work for the State Harbor Commission, which has been done altogether by contract. The contractor furnishes all labor and material, excepting the cement, which is furnished by the State. The State Harbor Commission pays for its cement $1.64 a barrel f.o.b. cars at San Francisco, Belt Rail-
5800 road. I think it has paid that price for the last 4 years; it was in effect when I entered the service of the Board for about 6 months, and I have been with them now about 3½ years.

I am familiar with the Crystal Springs Dam of the Spring Valley Water Co., and have seen that structure. Mr. Dockweiler took me down to the dam so that I might become familiar so far as I could in the limited time with the physical conditions at the dam site, and to use the knowledge so obtained as a basis for making an estimate of the probable cost of construction, the concrete only. I was to figure this construction as of December 31, 1913, using prices from 1908 to 1913. I made a study of the design of this structure. Mr. Dockweiler
5801 described to me in detail the method of construction, and also the character of forms used in making the blocks. I did not know the prices Mr. Dockweiler had placed in his appraisal of this dam. Our appraisals were made entirely independently. I did not confer with Mr. Dockweiler while I was making this appraisal.

Jerome Newman's tabulation of costs received and marked "Defendants' Exhibit 116".

I assumed a cost of $1.40 at the mill. The sheet that you are showing me in "Defendants' Exhibit 114" states the prices which were paid by the Southern Pacific Co. to the Standard Portland Cement Co. for cement during the years 1911 to 1913. Those are all the purchases from this company that took place in that period.
5802 There were other purchases from other companies.

5803 The table from the same exhibit, entitled "Purchases by Southern Pacific Co. from the Pacific Portland Cement Co. during the years 1909 to 1912", shows all the purchases made by the Southern Pacific Co. from the Pacific Portland Cement Co. during those years. The Southern Pacific Co. made other purchases during those years, concerning which I have not furnished data. There were some purchases made in Utah, at the Red Devil Mill, at a considerably lower price than either of these, on account of the mill being anxious to get out of business, and desirous to close out its stock. There were purchases made from the Santa Cruz Portland Cement Co., at Santa Cruz, at a considerably less price, on account of some freight agreement that was existing between the mill and the Southern Pacific Co. My idea in getting out these tables was to get a fair price of cement to a purchaser who had no agreement with the mill, but who would go into the market and try to get as fair a price as he possibly could.

My base price for sand in this estimate is 50 cents a ton at Niles. The table marked "Southern Pacific Co.'s purchases of sand", and which is a part of "Defendants' Exhibit 114", correctly states the 5804
prices paid by the Southern Pacific Co. for sand purchased f.o.b. Inward, on the American River about 4 or 5 miles east of Sacramento during the years 1908 to 1913. I also inquired at the offices of the different plants located at Niles, and the quotations I got varied all the way from 45 cents a ton to 55 cents a ton, and as an average I took 50 cents. I believe the Grant Gravel Co. quoted 45 cents; the California Building Materials Co. quoted 55 cents, and the Niles Gravel Co. 55 cents, with a possible reduction in large quantities. Those prices were quoted f.o.b. Niles. Two of those companies are at Niles, and the Grant Gravel Co. is at Pleasanton. One of my assistants got the price by telephone at the time of my estimate, and he said prices if anything were lower 2 years ago than they are at present. 5805

Lumber: Rough lumber f.o.b. San Francisco $14. That was based on contracts let by the Harbor Commission during the last 4 years, and on purchases by the Southern Pacific Co. going back to 1907 or 1908. I figure that the company would construct this dam itself, and that it would not be done by contract. I consider that the hauling would be done by contract.

Cement: Cost f.o.b. mill $1.40. To that is to be added a freight charge to San Mateo of 25 cents; the cement there is to be unloaded into the cement house, loaded out of the cement house into the truck at a cost of 6 cents for the two operations, 3 cents a barrel for each; hauling to the dam 17 cents a barrel; then the same operation of handling 5806
at the dam into the mixer, about 6 cents, making a total of $1.94 per barrel of cement in the mixer. At 1.24 barrels to the cubic yard, it would make $2.40 for the cement per cubic yard of concrete.

Sand: With a base price at Niles of 50 cents per ton, freight to San Mateo 25 cents, unloading from the car, and bunkering at San Mateo, 14 cents, hauling to the dam 71 cents, bunkering at dam 4 cents, total $1.64 per ton. There will be .45 of a ton for each yard of concrete, equivalent to 74 cents per cubic yard of concrete.

You can haul more sand per load than you can the cement. I figure on hauling 7 tons of sand to the load, and 120 sacks, or 30 barrels of cement, which would be 6 tons. I didn't figure on a base price per ton mile, but based this on the cost per day of a 7-ton truck, including the wages of the driver, and all repairs at $25, and five round trips per day from San Mateo to the dam. At 17 cents a ton for a 4-mile haul it will be practically 17 or 18 cents a ton mile for the sand, and the cement at 17 cents a barrel would be 21¼ cents per ton mile.

(It was here stated, by Mr. Hazen, that both he and Mr. Lawrence had checked the distance by speedometer on their automobiles, 5807
separately, and found the distance to be 4.2 to the bottom of the dam, and 4½ miles to the top.) 5808

The cement is unloaded from the car by hand to the cement house, and loaded by hand from the cement house to the truck at 3 cents a barrel for each operation, which is about what it cost us in San Francisco. The sand is bunkered by means of elevators at San Mateo, after being unloaded from the car by hand, the bunkering costing 4 cents, and the hand unloading about 10 cents a ton. I have provided just the bunkering at the dam, and the handling of the cement. I would have a cement house at the dam also.

Crushed rock: I counted on getting that from a quarry about half a mile north of the dam site, and figuring on using the ordinary crusher, hauling it to the machinery by means of cars, and elevator running from the crusher to the bunker. It would be hauled to the dam, a distance of half a mile, by auto trucks.

The Southern Pacific Co. gave me a freight quotation on lumber
5809 of 60 cents a ton. The unloading charges cover taking it off the car and placing it on the auto truck which is to haul it to the dam. The hauling charge is based on a 7-ton load, and a charge of $25 a day for the use of the truck and driver. I figure that the surfacing would be done in San Francisco, and have allowed for that $1.50 a thousand.

The crushed rock is taken from the bunker at the quarry and hauled to the bunker at the mixer; the sand and cement are hauled from San Mateo, the cement stored in the cement house, and the sand in the bunker over the mixer. A battery of 3 mixers would be used, 2 of which are in service, and one in reserve; a trestle built on the west side of the dam with a track for transporting 1-yard dump cars, 2 to the train, and at the edge of this trestle a movable hopper placed with flexible pipes carried down to wherever the concrete is to be deposited. My total labor charge for mixing, placing, tamping, maintenance and labor on forms, but not including material, is $1.05, and if you subtract the labor on the forms, that would make my labor cost 97 cents for mixing and placing.

5810 Questioned by Master.

The item of maintenance is the maintenance of the plant; it is the labor needed to repair the plant, and is a charge for rental of equipment.

5811 Superintendence and engineering 6%: That is based on my experience in railroad work, where the cost varies, depending on the size of the job, from 3% to 7% or 8%; the larger the job the lower the percentage of overhead.

Questioned by Master.

The figure $5.23 is the total cost of labor and material, and it is the sum of $1.05, and $4.18.

DIRECT EXAMINATION BY MR. SEARLS.

The superintendence and engineering refer only to the field engineering, and does not include the general office overhead.

Depreciation of equipment: That is 50% on machinery, and 100% on structures. Machinery is estimated at something like $18,000, and the structures at $27,000. The machinery included there is all the conveyors, the mixers, and the necessary motor. If my exhibit shows as to the crusher plant, equipment, maintenance and repair charges, then of course the machinery was not included in that depreciation. The structures included the crusher, bunkers, cement houses, and all other 5812
buildings wherever located. I did not consider the camp, because almost invariably the profit on the board of the men more than covers the cost of installing and maintaining the camp; it returns a small profit to the contractor in addition to these charges.

I am pretty sure that a 30 horse-power motor would answer anywhere in the plant, and I assumed that they use their 30 horse-power during the entire working time. I provided for 7 motors, and assumed that the load factor would be practically unity.

Road construction and maintenance: That applies to the small roads necessary from one part of the work to another, and does not include the road from San Mateo to the dam site, although it includes the maintenance of that road. 5813

My power charge I have taken at 3 cents per kilowatt hour, and I figured on $36 a day for 314 working days, pouring 500 cubic yards per day. I did not figure on having to pay any stand-by charges if the work were stopped; my 3-cent rate would take care of that, and the assumption that the machinery would be working all of the time I think would take care of that. I simply made a guess on that item of 10% to cover contingencies, casualties, etc., and as a rule in that class work 10% is very liberal.

Referring to the Fort Mason Tunnel, for the extension of the Belt 5814
Road, in which there were something like 12,000 yards of concrete in the tunnel lining, portals and retaining walls; the work was divided into 3 sections; first, the regular tunel excavation; second, the digging of a trench and the pouring of the concrete lining in the trench, and the subsequent backfilling, and third, the retaining wall. All of that work in the construction of the tunnel lining, in regular tunnel excavation, was carefully watched, and a force account kept on it, material prices checked up. The contractor furnished everything but the cement, which was furnished by the State. The contract price on the tunnel walls, retaining walls, and all other concrete except tunnel arch and portals, was $6.50 a yard. The Commission furnished the cement, and paid $1.64 a barrel for it, which would make the total cost of the work $8.14.

Questioned by Mr. Greene.

The contractor handled the cement. It was delivered to him at the work on board the cars. This contract bid is the only one I remember, because it was the accepted bid. There may have been others that were lower than that, although the contract was awarded to the

5815 lowest bidder for the whole work, which included tunnel excavation. I added for the cement per yard $1.64. Our mix was 1—3—6, and used just a barrel.

DIRECT EXAMINATION BY MR. SEARLS.

My experience with the Southern Pacific Co. during the last 5 or 6 years, the contract prices paid for concrete work varied, depending on the locality. They were for furnishing all materials, except cement, and all labor. It included work on pipe culverts, concrete arches, concrete culverts, bridge abutment, and other similar structures; they range from $5 a yard to $6.50; the contractor being required to haul the cement not over 4 miles, and to haul sand and gravel not over 10 miles. The contractor furnished everything except the cement.

Gay

Witness: Geo. R. Gay for Plaintiff.

5816

DIRECT EXAMINATION BY MR. GREENE.

I am 40 years of age, and reside at 582 10th Avenue. I am assistant to the president of the Santa Cruz Portland Cement Co., and the Standard Portland Cement Corporation. I have been in that business about 6 years, and am familiar with the market prices of cement during the last 7 or 8 years. Our prices are all quoted in carload lots. The carload quantity is fixed by the railroad company. During the last 7 years our prices at San Mateo have been almost uniformly $2.44 per barrel. That includes sacks, and there are 4 sacks to a barrel. Those
5817 sacks are charged for at the rate of 10 cents each, equivalent to 40 cents a barrel. A contractor is allowed a credit of 10 cents each for sacks returned to the factory in serviceable condition, and that price would apply as the fair market price during the period 1907 until 1914. There have been very few deviations from that price for general work. Our San Francisco price during that period has been about $2.30 a barrel in carload lots f.o.b. the cars. About 2 years ago there was a little flurry in the market, and cement was purchased for a short time at about $2.15 per barrel. These prices as I have named them throughout would be gross prices.

I can explain how the Southern Pacific Co. has purchased cement during the last 5 or 6 years for figures less than those I have just named. The Southern Pacific Co., and in fact any trans-continental railroad company into San Francisco can today purchase cement for $1.80 per barrel f.o.b. our mill. The reason for that is that their lines extend to factories in the East, and they are in a position to bring cement in here in competition with us. We realize that, and in order to avoid it, we simply put our price at a figure that they cannot afford to bring it in and deliver it here under.

The State Harbor Commissioners have, I understand, been buying cement for $2.04 per barrel f.o.b. cars at San Francisco, which would be $1.64 net, but you must understand that the sacks wear out, and the consumer pays for the sacks, so that their price is added to the value of the cement. The Santa Cruz Portland Cement Co., and the Standard Portland Cement Corporation, are not furnishing any cement to the State at that price. I do not know why they got it, but it has been running for some time. 5818

As regards the Highway Commission, that is different; our present price to the Commission is $1.80 at the mill. That special price was granted with a view to encouraging the use of cement in the construction of the highways. If our price for cement had been too high, the chances are the engineers for the Highway Commission would have selected a different type of highway. We have succeeded in prevailing on the Highway Commission engineers to use a large quantity of cement, and with that in view the price was fixed at $1.80. We were trying to open up a new market. We are now, and have from time to time, sold a great deal of cement to the State Engineering Department, and it is all sold at San Francisco $2.30 per barrel. 5819

Commencing with the Stockton Street Tunnel, we furnished the cement for that work to Jacobson & Bade, the contractors, and they paid us $2.30 per barrel for the cement in carload lots f.o.b. cars. We are now furnishing the cement to Storey & Co. for the Twin Peaks Tunnel, and they are paying us $2.30 per barrel f.o.b. cars in San Francisco at the easterly end, and at Elkton at the westerly end, the freight rates to those points being equal from our mill. At the present time the City of San Francisco has contracts with our two companies, and the other local cement companies, at a price of $2.30 per barrel for cement in carloads, and $2.55 per barrel for less than carload deliveries. Those contracts are for the year 1915.

When the question first came up of building the dam at Hetch Hetchy, our president agreed to furnish cement on a basis of $1.80 per barrel f.o.b. the mill for the actual dam construction, providing cement was used in considerable quantities, but with a special provision that any cement furnished for other purposes, such as power houses, railroad culverts, and the like, would be paid for at the going market price.

The established freight rate from our mill at Napa Junction, and at Davenport, California, to San Francisco, is 75 cents per ton; to San Mateo it is $1.25. The price at San Mateo, however, is based on the San Francisco price, plus the local freight from San Francisco back to San Mateo, which is equivalent to 14 cents per barrel. The construction of new mills, and the entering of new corporations into the cement business, has not affected the prices of cement during the past 10 years. A new mill coming into the market might want to market its product, and in order to do so, they may be able to place 5820

a lot of cement on the market at a lower price than the going market price, but that cement is not readily sought after, because it does not comply with the specifications by which cement is judged. It has not been proved.

I might say that during the last two years we have furnished a contractor named Rolandi with all the cement he has used. I think
5821 that he bought some cement two years ago, or a little over two years ago, when the drop was here, and that was on the basis of $2.15 per barrel. He has not purchased anything under that price from us. The city specifications require that cement shall be in satisfactory use for a period of three years before they will accept it on their work.

CROSS EXAMINATION BY MR. SEARLS.

I do not know that there is a combine in the cement business,
5822 and I have no recollection of the established companies cutting their price to meet the price of a new mill.

Perhaps it was not a wise thing for the cement people in the South when they found that the Water Board of Los Angeles had all the specifications drawn for a mill of their own to then sell them cement cheaper than the market price, because the experience of the City of Los Angeles in construction of a cement plant was a very bitter one. It cost the City a great deal of money. I do not think well of the Tufa cement that they used in the aqueduct.

The Santa Cruz Portland Cement Co. was laid out for 10,000 barrels a day. Up to the present time we are manufacturing about 6,000. The Standard Portland Cement Corporation has a capacity of about 2,500 barrels a day at its mill, but it does not operate to its full capacity at all times. I suppose a little plant starting out ought to have a capacity of 2,000 barrels a day, and that would be about
5823 700,000 barrels a year. I don't believe a new company would be warranted in cutting the market price, even if they could find a contract for 250,000 barrels of cement just as they were starting out. That is, if they were satisfied that their cement would come up to specifications, and if they were in a position to finance themselves. I have in mind a company that started without funds, and they will offer to sell cement at a less price, provided you will advance them the money. They resort to almost anything in order to get by, but after they have learned their lesson, the chances are they will make their price right, and stay there. I don't know that the established concerns found it was much better to get together and not have the cut-throat competition. We found it was better to have a staple
5824 price, and that is our price. If you don't want it, leave it.

Questioned by Master.

If we had a request for a proposal on 250,000 of barrels of cement in 1913, to be used at San Mateo, the price would not have been cut. If that business had come up when cement could have been

bought at $2.15 per barrel, and we were able to close the contract
while that price was in effect, we would simply add the freight from
San Francisco back to San Mateo, which was 14 cents per barrel, and
make a contract to furnish it at that price, $2.29 per barrel. We
aim to get the market price for cement for all uses we consider legiti-
mate for cement; for instance, if cement were to be used a long way
off in the mountains where there was a high freight rate, and where
the engineers might be actuated to select some other kind of ma- 5825
terial, if we could not furnish cement at a reasonable price, consid-
ering the high freight rate, and the order was a large one, we might
feel inclined to modify the price in some ways. These prices I have
quoted are all gross prices, and would be subject to the usual rebate
for sacks. Of course, as to any prices given for San Francisco, there
would be the differential of 14 cents.

Questioned by Master.

That is not merely our price, but it is the market price. The last imported cement I have any knowledge of here was a lot of 5,000 barrels, and the price was held so high that it was reconditioned three times before it was used, and they had to get rid of it at their own price.

Questioned by Mr. Searls.

I have no knowledge of what the Pacific Company may have charged Mr. Rolandi in 1912.

Questioned by Master.

My figure covers the period between 1907 and 1914. There was 5826
practically no change.

Witness S. P. Eastman for Plaintiff. Eastman

DIRECT EXAMINATION BY MR. GREENE.

I am the Vice-President and General Manager of the Spring
Valley Water Company, and have held that position six years. The
largest one order of cement that we had occasion to place was for
the flood water tunnel at Calaveras, and other small structures there.
That order was placed in 1913, and there were used about 27,000 bar-
rels. The matter of the order and the price were first taken up with
all of the local companies. They all submitted the same price, that
is, $2.49 a barrel f. o. b. cars at Milpitas. At the same time, inquiry 5827
was made to learn if any imported cement was in the market, or
coming into the market. We did not discover that any was coming
in. When we learned that the price was the same from all factories,
it was finally taken up with the Santa Cruz Co. They were asked
if they would make a better price basing the delivery upon 100,000
barrels instead of 27,000 barrels. They said that that class of work
would not warrant them in making any reductions. I asked them if
there were any other inducements that might be made in placing the

order which would afford a reduction, but the answer that was made to that was that that class of construction was such that nothing but the market price could prevail. That was in June, 1913. They sent an executed contract covering the price $2.49, and from that time until October 1st efforts were made to get a lower price, but when the time for the delivery of the cement came on October 1st, we had failed to get any better price, and that price was executed and conformed with.

CROSS EXAMINATION BY MR. SEARLS.

The entire 27,000 barrels were included in one contract. When
5828 the contract was signed we agreed to take immediate delivery, and to continue that delivery until the full amount had been placed. The terms were $2.49 f. o. b. cars at Milpitas, with a 1% reduction in case payment was made within 30 days, and a 7% penalty in the event that it was not made. That condition was in the contract, and I arranged subsequently by which we could pay later than 30 days without paying the 7% penalty. The result of it was we did not get the benefit of the 1%, and we were not penalized the 7%. We made inquiry about 1911 or 1912 as to what price we could get if we built a concrete dam at Calaveras, and I was informed that if we were ready to place an order of sufficient quantity for a dam built entirely of concrete, they would give a quotation at that time.

Hazen

Witness: ALLEN HAZEN for Plaintiff.

CROSS EXAMINATION BY MR. SEARLS.

In figuring the cost of materials which would go into the Crystal Springs Dam, I had heard some stories about prices at which cement was sold, but I did not consider them as a safe basis on which to predicate an estimate.

5829 The Ashokan and Kensico Dams are within 25 miles of water competition. The large shipping point there is New York City.
5830 There is a port at Kingston, right opposite the dam, and large barges can go up there. The old State Canal went by the Columbus Dam, but that hardly afforded effective competition. Pittsfield is up in the hills, and is probably 130 miles from Boston, but only 40 or 50 miles from tide water at Albany. The Wachussetts Dam is about 40 miles from Boston. The Cross River is, say, 30 miles from New York; that would also be within 25 miles of tide water. The Springfield Dam is within 25 miles of navigation on the Connecticut River, but I do not think that cuts any figure in the delivery of materials. It is about 136 miles from New York, and about 99 miles from Boston.

I think the difference, so far as the climate is concerned, would be very slight on the working conditions at Crystal Springs as com-

pared with these other dams. I do not think it would be a material factor in the comparison. I think the number of days you could work in California would be a little greater than the number you could work in New York, but it would affect the overhead charges very slightly. There would not be the same comparison with masonry dams as there would be with earth dams, because a rain storm does not interrupt the construction of a masonry dam and add to the cost and subsequent expense as it does in building earth works.
With the earth work the rain softens the road and the material, and 5831
it is very much more difficult to handle afterwards; in cement work there is not any appreciable amount of earth or material being handled on earth roads. It all goes on tracks or other means of conveyance, and rain does not make any appreciable difference.

Freezing weather does not have much of an affect on dam construction. They used to shut down dam construction for the winter, but as the business has developed, the period of shut-down has been shorter and shorter; heavy masonry is placed with a short interruption for the most severe winter.

There is a substantial difference in the difficulty of handling water during construction, but I excluded that particularly from the Eastern figures that I used. I have had those costs, and I can tell you about them, but it didn't seem necessary in this case, as you do not have the same risks here. The prices that I have given you on all these Eastern dams do not include any provision for handling the water. I could not say there is not a cent of allowance in any of the lists, but substantially that is true.

Questioned by Master. 5832

That is included in my $9 for Crystal Springs. I intended to cover that by a small allowance; it is not predicated on Eastern experience. I left it out of my Eastern experience because I had so little water to take care of here. On the Wachussetts Dam the care of the water amounted to about $1 a cubic yard on the whole structure. On the Little River Dam it amounted to considerably over $1 a cubic yard. I should think it might amount to 10 cents for the Crystal Springs Dam.

CROSS EXAMINATION BY MR. SEARLS.

By taking care of the water, I mean the stream, and not the bringing of water on to the work for construction purposes. The first thing that would have to be done in building the Crystal Springs Dam would be to build a coffer dam across the stream up-stream from the work, and another coffer dam across the stream downstream from the work, and connect the two with a flume to carry any flows that had to be carried during the excavation and refilling of that part of the work below grade. That is not covered in the

schedule in any way. The handling of the water on the Ashokan Reservoir construction was a pretty expensive undertaking. The
5833 contractor did not pay a cent of that; the city did a good deal of that work in advance of letting the contract, and I expect the contractor did other parts of it, but so far as he did it, he was paid other and separate prices. Not a cent of work with reference to the care of water went into these prices which I have quoted to you. I do not know how much the contractor was paid for handling of water in that reservoir.

I know Mr. Lazarus White, who was engaged by the New York Board of Water Supply on that Ashokan work. Referring to an analysis of the cost of the Ashokan Dam written by him, in which are shown for the control of stream flow $20,000, so far as the contract is concerned, and the fact that the city may have done some work outside of that; that is my understanding that the city did a lot of work. That seems to be a price of $10,000 for some control of stream flow. The second $10,000 does not relate to the Ashokan Dam, but relates to the middle dyke, which is a separate structure. Presumably that $10,000 completely compensated the contractor for all his work in the control of stream flow. I see another item for
5834 removing the steel pipes, $10,000, and I think that also is a part of the control of water.

I think there is a little difference in favor of San Francisco in the price of lumber.

I have had experience in building dams where I used cyclopean masonry. That was the Springfield Dam. I have not, myself, built any outside of that. My cost of $2 to $3 a yard in place on plums is based on my judgment as to their cost. I did not have the cost of plums in any of those dams as separate from the cost of the rest of the masonry. That figure is my judgment of the cost of getting the material and placing it in the dam as it ordinarily has been done.
5835 There does not seem to be any possibility of plums in this case, so that no analysis is possible. The fact that plums have been used has been one of the most important elements in reducing the cost of dam construction in recent years. The putting in of a plum that weighs anywhere from 1 to 10 tons, and that is taken up from the quarry or stream bed in the neighborhood, and is handled by machinery, and goes into the dam and takes the place at once of expensive material, which is represented by an equivalent volume of concrete—while that figure is my judgment, there is not any question at all but what that method of construction cheapens tremendously the cost of the dam work. I do not think I can give you a detailed schedule that will show the cost of plums. I do not think it would be the same on any two pieces of work. That is my idea of a fair representative estimate of the way the work has been handled, as I have seen it on dams I am familiar with. I did not make an analysis on

my Springfield dam as to what the plums cost, nor have I made a particular analysis on any of these other Eastern dams.

I would say that I have not said anything about the cost of 5836
plums here, but in considering the probable cost of this dam, as far as it was indicated by the cost of other dams that I have known about, I took into account the fact that plums were not available here, and that plums have been a very important element in the cost of the dams I have known about. My estimate is not based upon a detailed estimate. I know that wherever plums are available the work is cheapened; the amount of plums is ordinarily optional with the contractors; the contractors make a strenuous effort to get in all that they can, because they save a great deal of money by doing so. I do not know of any dam in California where plums constituted 1/3 of the volume. I do not remember the proportion of plums in the Ashokan Reservoir. If Mr. White states that there are probably 25% used in that reservoir, I have no reason to doubt his judg- 5837
ment. The proportions vary in different dams from 10% to 40%. In the Cataract Dam they ran as high as 40%. I doubt if anyone knows accurately what the percentages are; I am inclined to think that in the Ashokan Dam that was Mr. White's estimate, and it is not a matter of measurement. I do not think anyone knows exactly what percentage of plums is in that dam. It would be difficult to determine just how much the dam was decreased to the contractor by the use of plums. I think a fair approximation could be reached.

I think there was somewhere in the neighborhood of 10% of plums placed at Spaulding. The superintendent at Spaulding seemed to think that it took more time to place plums, but I should not con- 5838
sider it so.

Referring to the Ashokan Reservoir; in the masonry at $6 per yard I have included 280,000 cubic yards of concrete masonry at $4.90 per cubic yard—that does not include any plums—475,000 yards of cyclopean masonry at $3.40 per cubic yard; 55,000 yards of cyclopean masonry at $3.90 per cubic yard. 1,100,000 barrels of cement at $1.50. Total 810,000 cubic yards at an average of $6 per cubic yard. In comparing this dam with the Crystal Springs Dam possibly it would have been better to take the concrete masonry which would have afforded a more direct comparison instead of taking the average as a whole and attempting to make an allowance; however, as I went over it, it seemed to me that taking the entire structure was a fairer basis than trying to split it up in this way. So far as the concrete masonry is concerned, there was no advantage there over the Crystal Springs so far as plums were concerned. I include plums in the handicap which I had to the average price of these dams in order to check my estimate on Crystal Springs Dam on the average amount. 5839

Presuming the full concrete mixture to be cyclopean on the

Ashokan Dam; the mix was varied somewhat according to the judgment of the resident engineer; that is why the cement is paid for separately. The price of cement is not the actual cost of cement; it is the price that the contractor bids as a part of his work, and presumably includes not only the cement, but his estimate of handling the cement into the work. The $1.50 a barrel represents something more than the cost of the material; the cement on that dam
5839½ costs more nearly 1.25, but this was the price which the contractor received for the cement which was used in addition to the price for each cubic yard of material which he placed. We can approximate the contract price for placing that cyclopean masonry: Assuming it is the same for the two classes, which it would not be, it amounts to $2.03 per cubic yard for the cement, which would make the concrete masonry cost $6.93, and the two classes of cyclopean cost $5.43 and $5.93.

5840 I will accept your average price of $3.45 on the cyclopean masonry on the Ashokan work. It seems about right without the cement. I would add to this for the cement on this calculation $2.03. That would be about $5.50. It shows that the concrete cost $1.45 more per cubic yard than the cyclopean; so far as it shows anything, and I do not think it goes very far towards showing it, it indicates that that is the measure of the handicap of concrete as compared with cyclopean masonry in this particular instance.

Bechtel

Witness: W. A. Bechtel for Defendants.

5841 CROSS EXAMINATION BY MR. GREENE.

The figure of 280 ton miles per day is for a 10 hour day. The trip from San Mateo to the dam would be at the rate of 5 or 6 miles an hour, and I think it would take an average of an hour for a round trip. You would have a little added cost to the cement, but I have allowed a swamper for every trip that is made during this 10 mile haul; for the hauling of sand and gravel you would not need a swamper. This extra cost might be thrown in, but it would not cost that much for the extra cost of loading the cement to keep these machines going. You would have to hustle to haul cement that fast to get so many trips in a day. That would be covered
5842 by the extra cost. The automatic devices for dumping the sand and gravel are not included in the haul. If you were to assume that the distance from San Mateo to the dam was 4½ miles, my ton mile cost would be increased by 1/9th, less the allowance for loading and unloading, which would not be changed.

The 25% overload is a constant overload each trip that you make.

5843 The road cost I said would be in the neighborhood of $7,500 to $10,000 on the job. I took a total of a million tons that I had to

transport, and I divided that by the number of trucks which I proposed to use, 7, which gave me 142,000 tons per truck. Then I took that 142,000 tons per truck, and assumed there would be 500 working days, and divided the 142,000 by 500, which gave me the 280 tons per day, which I assumed would be carried. Every job has a different way of arriving at its cost. I have a leeway of 230 days 5844
for the truck to pick up what it has lost, due to accidents, or I have allowed two years to do the job in, and have only taken 500 working days. As far as the total amount which I carry per day is concerned, it is reckoned on this basis which I have just recited. I have assumed that the trucks would be working 500 days.

In 1912 and 1913, and a portion of 1914, I had a job where I had 5 to 8 trucks working. It covered a distance of 50 miles, and in that time I did 2,000,000 yards of excavation, 7 tunnels, and 20,000 yards of masonry. There was never at any time all of the trucks at 5845
work. We had some of them in the shop all of the time. In this Crystal Springs job I have taken two years to put in 500 days, so that they can be idle practically 1/3 of the time, and I can still complete my contract on time.

I have driven over the road from Milpitas to Calaveras on two 5846
or three occasions when they were working there. There were very evil roads in places there, and I would not be surprised if the price ranged from 28 to 38 cents per ton mile. My costs over heavy mountain roads which are not to be compared with these roads in San Mateo County were 20% more than the cost to the Calaveras Dam. That would be between 35 and 40 percent per ton mile, but I want 5847
to qualify that. A man would have to drive over our roads that were hauled over to appreciate them. Some people would not ride in an automobile over them, to say nothing of a truck.

The price of hauling in Calaveras was amply justified, because there was no up-keep to the roads that I could see. They were traveling in the dust and ruts, and that adds to the cost. Besides, you had a very hard, long hill. Undoubtedly the hill at Calaveras is much longer, and a harder hill, than the one from the foot of Crystal 5848
Springs up to the top. When I made my estimate, I made my figures on carrying this earth to the top of the dam. That includes everything, cement, gravel and sand.

I would probably want a little more money going to Calaveras 5849
than I would from San Mateo to Crystal Springs per ton mile, if the roads were in an equivalent condition, on account of the length of the hill; the rate would be proportionately a little higher, taking into consideration the condition of the road. If I had the actual figures as to what it had cost other people to do similar work, I would heed those figures only to a degree. It would depend on who the contractor was whether I took them or not. The item of repairs is based on my own records of cost, and as near as I can make a com-

5850 parison between the two. In offering a bid, we have to assume something as a basis, and I tried to take an equitable figure for this. I have never had a really similar job, but I presume this is an equitable figure for the cost.

Bechtel's estimate of hauling cost received and marked "Defendants' Exhibit 117".

Hazen

Witness: ALLEN HAZEN for Plaintiff.

CROSS EXAMINATION BY MR. SEARLS.

On the Ashokan Dam we used more than a barrel of cement to the yard of concrete. I can't tell you the mix, because under this contract the resident engineer had the privilege of varying the mix as he liked, and to pay for the cement separately. It would cost a minimum of $6.40 if he only used a barrel, but he used more than that on the concrete, so that it would cost more than that. I should
5851 think a barrel and a quarter would be about right, and that would make it about $6.75. The $4.90 does not contain any allowance for difficulties of contractor handling water. If he met any difficulties growing out of stream control, he was entitled to extra payment for it. This does not include any allowance, whatever, for that. I have the contract in my possession in New York, and I have studied it and been on the work, and I think I can state that positively on that point.

5852 Kensico Reservoir: There were 2500 cubic yards of concrete at $5.75; 35,000 cubic yards of concrete at $5.25; 900,000 cubic yards of cyclopean at $2.65; facing masonry 40,000 square yards at 15 cents, included in the price, but not in the yardage; that is the price for facing and not for blocks; 60,000 cubic yards of blocks at $7.50; 900,000 barrels of cement at $1.50. Total 997,500 cubic yards, $4,394,400, an average of $4.41. This is the contract price, as the others were. It does not represent cost of the finished work. The cyclopean masonry cost $2.65 a yard in this case, plus the cement. The $4.41, the average, was the cost of the cyclopean masonry. There is not any substantial amount of concrete. Instead of putting up wooden forms in this case, the contractor in advance made concrete blocks which were placed by derricks on the side of that dam, and those blocks took the place of the forms in the construction.

Referring to the Cross River item of $6.80: There were 6,000 cubic yards of concrete at $6.50; 132,000 cubic yards of cyclopean
5853 masonry at $5.50, and 135,000 barrels of cement at $1.30; total 138,000 cubic yards, costing $940,000, or $6.80 per cubic yard. These differences between the concrete and cyclopean in these cases, really represent the bidder's idea of the excess cost of the concrete as compared with the cyclopean. They do not represent the actual difference as it worked out, but these dams were all built by very ex-

perienced bidders, and I think in that way they do give something of a guide to the saving probably made by using plums. It is not a clear cut definite indication, but it has some weight. I do not see any reason why any reduction should be made in the Crystal Springs, on account of having included in the Ashokan, the large volume of concrete masonry, because I have taken the contract prices for these dams as they stand; in using them I have applied a correction for the average amount of plums which I have thought they contained. If we took some part of the masonry, obviously the correction would be based on the plums which that part of the masonry which is taken for consideration contains, and that would not be 25%, it would be 5854
something else. I think that the comparison, as I made it, is the fairest basis of getting at it, but if you want to split it in that way, the first thing that would occur to me would be to take the prices for the concrete separately, and then there would be no allowance for plums, and we could go ahead and make a comparison on that basis. I did not do it, but it could be easily done. These figures would certainly support the difference between the concrete and cyclopean which I used as the basis in my estimate; probably it would support a somewhat larger difference.

I have never had any experience in hauling contracts in the Western States. I have not heard of any contractor in California who paid $6,000 per mile for road repairs over a period of three years. My experience in hauling with motor trucks was about in 5855
1909. They seem to have made their appearance in our work a little bit earlier than in California. On one of the Springfield Reservoirs, the work was located on the top of a hill, some miles from the railroad, and I drew the plans and contract so that under one section the contractor who built the reservoir was to build this road and maintain it, and turn it over to the authorities at the end of the work. He built a beautiful road, and then got his motor trucks and started to haul the material, and the minute the material, which was very much less than would be involved in the construction of the Crystal 5856
Springs Dam, started to go up, it went up all right, but before he got through his road was gone, and we built it over before we got through at the expense of his bondsmen. He was broke. The road he built was done in the best Massachussets practice. It was an upgrade road, and he graded it. It was all solid, and not built on embankments.

I saw the road running from San Mateo to Crystal Springs prior to 1914. I have only a general recollection of it, but it was a country road that I think had been macadamed for the greater part, but was somewhat rutted. I do not know whether there was a great deal of heavy truck hauling from Half Moon Bay across the grade to San Mateo over that road prior to its being surfaced with as- 5857
phaltum.

I made some inquiries as to sand, and I visited one of the places where sand is produced for sale, and I saw some of the others along the line of the railroad at Niles and in the Livermore Valley. I did not get any quotations from the sand producers. These quotations in my experience do not mean very much. The sand that is needed has to be pretty good sand, and when one gets quotations from concerns at prices, it does not follow that the sand represented by them will meet the requirements. I took the quotations from the Spring Valley purchasing agent, but I should not have taken it if I had not considered it a reasonable one, and in line with my experience in getting sand out elsewhere from deposits of that kind.

5858 On my plant equipment and forms I have made a flat allowance of $2 per yard. That would amount to about $314,000 on this job. I cannot give you a detailed schedule of it, because I have never personally handled work in that way. I have never taken it up from the contracting end. I have never bought the equipment and assembled it. My idea of the cost of the work is made up from observation of the cost of work as similar to this as any that I could find, and not upon building up all the things that I could think of that would enter into the cost of the work. I do that because I do not think that the building up process is reliable. If a contractor is a wise man, when he figures on a bid, he figures on past experience. I should say that the greater majority of contractors who start out bidding on work of this sort go into bankruptcy before they get very far. The ones that succeed are the ones that are successful in estimating, and before they get very far they base their judgment on what they have done, and on what other people have
5859 done that they know about. I do not believe successful contractors go very strongly on estimates built up by all the elements that they can think of. It is rather a case of getting at what the last job cost, and then trying to size up the differences between the last job and this one.

5860 I am inclined to think that a job a long way off which was a good deal like the job under discussion, even with the handicaps of different labor conditions and climatic conditions, and so on, might be a better guide than other kinds of work nearby. Your ideal basis would be to find a man who built a system just like the Spring Valley system under these conditions. Unfortunately, nobody has done that, and we have to base our estimates on work that differs in a good many respects from the work we are estimating on. I think that a comparison between a structure that is somewhat comparable with another structure, even though the difference is pretty great, is a handicap to the accuracy of the estimate; there is no question about that. Speaking of the Kensico Dam, the equipment that was placed for that dam received quite a good deal of notoriety, and the contractor, whom I know, has talked it over with me with others,

and while I do not know his figures, I have a pretty definite idea what that plant represented. I would not say that the Crystal 5861
Springs Dam should be constructed with the same type of equipment, and by the same methods that the Kensico Dam was constructed, but so far as I know the equipment used on the Kensico Dam has been in many respects the best, and has produced the most economical results of any that has been used up to this time.

The topography of the country at the point where the Kensico Dam was constructed is pretty fairly similar to that at the Crystal Springs Dam site. The Kensico Dam is a somewhat bigger dam, longer and somewhat higher, but the hills on either side are similar, and as it happens, there is a little island at Kensico a little out from one valley that comes up above the flow line, and the contractor's cement plant is located on that, just as the defendants' engineers have proposed reconstructing the Crystal Springs Dam.

On the Kensico Dam they started with cableways; the cableways system has been used on nearly all of these dams. The cables carried the very heavy moving derricks that run on tracks on either side of the dam; I should say from memory there were four of those cables. The cableway has never been successful in handling the concrete from the mixer right to the point of use with sufficient speed; they have to drop it out in other ways. It has been common to use derricks to move the skips about the dam and put them just where they were wanted. Those derricks used to be set on top of the masonry from time to time as the work proceeded, but it is a 5862
little slow setting up the derricks on top of the irregular masonry, and an improvement was made in the New Croton Dam several years ago, where, in order to get the work ahead faster they built a steel frame, which was a sort of an outline of the central part of the dam. They built it up a good deal like a steel office building, and the derrick was set up on each successive stage of this steel building, and then the steel was built into the dam. In the Kensico Dam they have improved on this system by building this skeleton that carries the derricks of reinforced concrete; they case the members out one side separately and put them up as the work proceeds; the derricks are set up on those; they take the skips and the plums and distribute them where they are to go, and do all the other moving that is required on top of the dam.

EIGHTY-FIRST HEARING. DECEMBER 16, 1915.

Witnesses: ALLEN HAZEN for Plaintiff.
GEO. L. DILLMAN for Defendants.

5863 CROSS EXAMINATION BY MR. SEARLS.

(Certain corrections noted in the record.)

The difference between the price of the concrete masonry and the cyclopean masonry in the Ashokan Dam tended to corroborate my testimony on the value of plums.

5864 Kensico Dam: I told you about the cableways and the derricks, and the method of supporting the derricks, yesterday. The cableways do not give capacity enough for transporting the material going into a dam rapidly and to supplement that they run tracks on these reinforced concrete forms or skeletons, so that the cars from the quarry bring the plums and other materials directly on to the dam, and then the derrick takes it from the cars and puts it in place, so that that is an auxiliary part of the system of handling the materials that is very important, and contributes to the results that they get.

Instead of using forms ordinarily on many of these dams, and on this dam in particular, they built concrete blocks and laid them up to form the outside of the dam. There is a plant for making these blocks that is near the work, and there is a yard which contains the forms, and traveling cranes that go from it. The material is mixed and carried in skips to these forms, and they are filled and allowed to set, and then the forms are removed, and they are piled up to season a considerable length of time before they are used. The concrete mixing plant is on one end of the dam, and consists of mixers and bins to contain the various materials. The materials are all brought to the bins by cars going to the quarry and to the sand bank.
5865 The quarry is on one of the hills above the dam, so that there is a continuous downhill haul, and the plums and the broken stone come from the same quarry. Then there was a concrete plant with screens and other appliances for preparing the stone. In addition to this equipment, there are blacksmith shops and machine shops for keeping all the appliances in repair. The machinery is all operated by electricity, and a power line was built from New York City to the site of the work, and it is arranged so that the work is all done off the peak load. The power to operate the whole system comes from the Edison Co., at New York, at a very low rate in consideration of taking it off the peak load, and the hours of work on the dam are somewhat unusual on that account.

Questioned by Master.

You might have to pay more for your labor, but you save on your power. The equipment also includes the offices for the con-

tractor's business, and also a model city where the men live. I do not give that as a complete catalogue of the equipment, but simply as an outline of the most important parts of it.

CROSS EXAMINATION BY MR. SEARLS.

The plums are quarried in as large blocks as can be handled, and they are loaded on cars, and go from the quarry to the dam on these tracks; they are taken from the cars by the derricks, which put them 5866
in position in the dam. The general method of procedure is to take a place where the top of the dam is low for the time being, because other parts around it have been built up a little higher, and to put a certain number of skip loads, that is several cubic yards, of the soft concrete into this depression. Then the plum is brought with the derrick and lowered into this soft concrete. It is usually lifted and lowered several times to move the concrete about and help in the seating, and it is worked in that way until the men bring it down to a very low position where it is nearer the plums that have been previously placed, and in such a way that all the spaces between it and the preceding ones are entirely filled with concrete. The top of the plum usually projects some distance above the soft concrete in which it is placed. Usually quite a large pool of soft concrete is placed, and quite a good many plums are placed in it before the operation at that part stops for the time.

Questioned by Master.

The derrick runs on tracks on either side of the dam carrying the cable. (The witness here referred to a photograph, pointing out the derricks and the counter weights which take the stress on the cable, explaining that the cable comes from the top of one derrick to the 5867
top of the corresponding derrick on the other side, and that the equipment that carries the skip is moved back and forth on these cables so that loads perhaps of 5 tons may be carried rapidly from the end of the dam where the contractor's equipment is, and where the picture was taken, out to any point over the dam, and then lowered to the point where it is wanted.) Some of the material is carried in skips over cables, and some is carried on tracks. They have no method of pouring by a flexible tube.

CROSS EXAMINATION BY MR. SEARLS.

The rock at the quarry is very excellent rock, and I think it takes very little splitting and chipping, but there are occasionally inferior pieces in it, and that would have to be removed. The idea is to get away from air chambers in the material as far as possible.

Referring to the Ashokan Dam; I expect that the concrete masonry, of which the contract price was $4.90, exclusive of cement, included all the masonry which is placed in the core-walls on the dam 5868
and on the dykes, and also the masonry in the weir. These cut-off

walls correspond exactly to the work in the Howard Cut; that is, through the water embankments which back up the dam. The masonry dam comes across the principal valley, and on either side there are these dykes which are virtually extensions of the dam, and these core-walls were built in them, and I expect this $4.90 does cover that. There were considerable masses of concrete in accessible places, and the sidetrack of the railroad to the dam follows right along the line of this work, and all materials were easily delivered. I think they would be placed twice as cheaply as the main dam. I do not think that that was cyclopean masonry in those core-walls. The masonry in
5869 the overflow weir could be placed as cheaply as in the main dam.

I doubt if Mr. White knew how many plums were employed in the Ashokan Dam, but he had facilities for finding out about it, and I have no doubt that he endeavored to make an accurate estimate, and I should not question that it was as nearly right as he could get it. He is correct in stating that the cyclopean stone were thoroughly cleaned and wetted before they were lowered into place by the derrick, and well bedded by juggling with iron crowbars. The Cross River Dam was built by substantially the same method as the Ashokan. At both they used the cableways and the derricks on the masonry,
5870 but I think they did not use the reinforced concrete framework which was used on the Kensico Dam in either case. The Cross River and the Ashokan were built by the same contractors.

The Wachussett was built by substantially the same people. It was earlier than the other dams of this series, and was the earliest that I included. A large part of the Wachussetts Dam was built of rubble masonry laid in natural cement.

Natural cement is the native cement that we had before Portland cement came in, and it was used very extensively. It used to cost about $1 a barrel, where Portland cement cost from $2 to $3 a barrel in the East 20 years ago. It was very extensively used where the work was not exposed to frost, and they used to economize by using the natural cement in the interior of the dam, and the expensive Portland cement only on the outside, but since the Portland cement has been made in this country so cheaply, the difference in cost between the two has been reduced so that the natural cement has practically been driven out by the Portland. The contract price of the
5871 Wachussett Dam, as I gave it was $4.63 for the masonry, and $1.48 for all other items, making $6.10 as the contract price, and the actual cost of the completed work was $7.72 per cubic yard.

CROSS EXAMINATION BY MR. SEARLS.

The $7.72 does not correspond with the $4.60. It includes the other item which corresponds to all the items except masonry that go to make up our schedule on the Crystal Springs Dam, and for the Crystal Springs Dam those items amount to $1.70 per cubic yard. For

the Wachusset Dam they amounted to $1.48, but to that I think $.51 should be added for the preliminary and additional work, making a total of $1.99 for all the other structures outside of masonry. The complete cost of the concrete itself was quite considerably increased, being to some extent due to reclassification of the masonry. I think that was principally due to using more Portland cement and less natural cement than was intended. Both were included, but I think they increased the amount laid somewhat with Portland. There was an allowance for the extra work amounting to 18 cents per cubic yard, and the contractors made claims for various things in connection with the work which were finally settled without litigation for an amount that was equal to 32 cents per cubic yard, $88,200 exactly. There was temporary work paid for which was not done under this contract, amounting to 44 cents a cubic yard. That does not include any engineering or interest.

Springfield Dam: After the excavation was made, and the coffer dams and flumes for caring for flood waters during construction, a 5872
concrete mixing plant was built on one end of the dam, and I think two cables were stretched across the stream from side to side over the dam. The concrete was mixed from sand obtained in a bank a short distance uphill, and other broken stone and gravel obtained on the site, and cement brought in. That was put down in the bottom of the excavation. These plums were obtained mainly from the bed of the stream immediately adjacent. I should say, perhaps, the largest stones we handled were in the neighborhood of 5 tons. These stones were brought on the dam and were handled by derricks which also handled skips of concrete to move them about on the dam after they were deposited by the cableways. Those derricks were set directly on the stone work. The forms were made from lumber secured in the immediate neighborhood, and in that case I think the lumber was as cheap as any lumber that could be got in California, and as good. We had beautiful hemlocks that had never been cut, 4 feet in diameter, perfectly clear lumber without a knot or defect in them. That is very unusual in New England, and it happened in this case only because this valley was so wild that it had not been worth while for any lumberman to go in and cut it.

The forms were made by a system that has been used where the concrete block system has been used for the outside quite commonly. 5873
We started with timber perhaps 6 x 8, and about 9 feet long, and each stick has 3-inch holes bored in it at exactly the same distance on centers; every center of the whole outfit has to be interchangeable to make the system go. These are set up, and the planks against which edge the masonry has to go are placed on the inside forming the shape of the dam. This Little River Dam was a curved dam like Crystal Springs Dam, so the problems in forming were just the same as they would be here. These sticks are set up to the required shape,

and the planks put against them, and bolts are put into these holes projecting quite a long ways into the dam, so that when the dam is built these bolts would be firmly imbedded in the concrete. When the masonry has gone up about halfway on these sticks and the planks that they support, and has set, the nuts on the outside end of the bolts are taken off, and the form is loosened and lifted. It is usually lifted by the cableway, because even a section of the form is quite a heavy structure, and could not be handled by the men without some machinery. It is lifted up just the distance between the bolts, so that a bolt that is put at the top goes down to the middle, and the one that was at the middle goes down to the bottom, and they are put in place again, the nuts are put on, and that serves for the basis for the next operation. The sticks are not true enough to form the lower surface of the dam exactly, so they are cut back so that they will always fall a little distance back of where they are wanted, and then they are brought up to the required line, which is given by the engineers, and by putting other pieces of wood on them, either nailing them on or putting wedges on front, the planks which have been used before and taken off are put on again in a new location, and that process is repeated all the way up to the top. In
5874 forming the crest of the dam, and the toe, and the abutments, a great many forms are required, and these forms for the most part are special, and have to be made by the carpenters, and are not used again.

We did not use any interior wooden forms in that dam. What we did was to form little walls of good stone, obtained from the bed of the stream, and they were laid up by a stone mason to form a rough wall that confined the days' work and if they had been left, and the next work placed against them, there would have been openings in that stone wall that would have meant leakage, so what we did, after the concrete had set back of the wall was that the mason went on the work before it had gotten very hard and took out the stone wall, and threw the stones somewhere else. Then the new work went solidly up against the work back of the stone wall, and in that case the work was made very solid. That was an arch dam. We depended on the arch for support, and it was not thought necessary to make any other joints that were made in that way.

Questioned by Master.

We did not make any expansion on it. I contemplated expansion joints in my reconstruction of the Crystal Springs Dam, as I think they ought to be built in a dam as large as that; it is only a
5875 matter of size. These would require forms. In the case of the Little River Dam most of the concrete went out on the cableways in skips, and then the derricks moved the skips to the point where it was wanted. I think some of the concrete nearest the mixer was spouted down from the mixer into the parts of the dam near it. The spout-

ing was not permitted to go very far, because in order to spout with the equipment that we had there was a tendency for the different parts of the concrete to get separated, and it was not possible to get them back again.

My experience with spouting has been limited. It has been tried on various pieces of work, but has always resulted in this separation; the sand and cement would get in one place, and the balance would get in another. For that reason we have always stopped it before it went very far, but I have been told that the method has been developed of overcoming that, and so far as that has happened, and is available and tested out, I have not any prejudice against spouting. If it was defectively done, it would mean both lack of stability, and a tendency to leak. 5876

CROSS EXAMINATION BY MR. SEARLS.

In the equipment we used for spouting, we did not use flexible pipe. I am not familiar with the methods which have been used in the construction of all of the dams in the West. For all I know, it might have been used on some one or more of those. I might say, in that connection, that I have had, I think, quite an extended experience with new methods. On at least half the pieces of work that have been carried out under my direction, some new method has been proposed and used, and the contractors commonly have been very optomistic about it, and have expected to cut their costs in half. 5877
In some cases they have done very well, but in a great majority of cases the new methods have been disappointing, and in some cases they failed entirely. In other cases the expected saving has not been realized, so that so far as I am concerned, I would make no estimates on improvements that have not been demonstrated in actual work.

The puddle was the old-fashioned way of making things tight. It has been pretty largely replaced with concrete and reinforced concrete in the last ten years. I have seen this year most of the reservoirs that have been built on the Pacific Coast in that period, and a somewhat longer period. Mr. Mulholland has not built any of his reservoirs that way. Mr. Adams did not build any of his that 5878
way, and Mr. Schussler has not built any reservoirs, but outside of that, pretty nearly all the reservoirs have been built depending upon concrete making them tight in place of puddle, and without submitting a schedule, I think that two-thirds of them would leak badly. They would have done much better to have stuck to the puddle; they saved money by substituting concrete, but it was an economy that was dearly paid for.

Questioned by Master.

The Spaulding Dam was not an earth dam. I think the Tabeaud Dam dispensed with puddle and used selected material. There are some materials that are so tight that puddling is unnecessary. If

you have a very excellent type of material you can dispense with, or greatly reduce your core-wall, but it usually costs a good deal more per cubic yard to place that kind of material than it does a lighter, more sandy, and more easily handled material. When you have the other kind of material, you have to puddle more carefully, and the cost of the whole work per cubic yard isn't as different as one would think, but there are parts of the country where the or-
5879 dinary soil makes water-tight work, and, of course, where that is the case, it is unnecessary to incur the expense of puddling.

CROSS EXAMINATION BY MR. SEARLS.

I cannot give you a schedule of just what a contractor would use for plant equipment and forms, but in my judgment a contractor would not be justified in assuming that he could build and maintain a plant adequate for doing that work, including the forms, for a sum materially less than that estimate. I would not attempt to segregate the cost of the forms from the cost of the equipment correctly, but I think the forms would probably be done for 40 or 50 cents a yard, using good Oregon pine formed and laid up in the way that I have described as actually having been used in the Little River Dam. I would not consider it possible to wire the forms in this case. You want your dam to be true, and you also want to put it in large units, and if you wire it, your wires would ordinarily be at least 10 or 12 feet long, and with a big mass of concrete coming against the forms, the stretch in the wires, I am sure, would result in bulges in the front of the work that you would not want, and besides, I do not believe the wiring system could be done as cheaply as the system that I have described. I should assume there would
5880 be some interior forms, but even so, your wires would have to go the entire width of one block, and they would certainly be so long that the stretch in the wire would make the system an intolerable one, and besides, you would not want the wires in the way of handling your concrete. It does not interfere with keeping building or walls in good shape to a pretty good height, but that is a different proposition; you have a wall anywhere from 6 inches to 2 feet in diameter, and you wire that across. The height does not have much to do with it, because you pour it in moderate sized buckets at one time.

Questioned by Mr. McCutcheon.

I should say that you would use for these forms timber something like 6 x 8. Soft concrete exerts a pressure just about twice as great as a like depth of water would exert, and they have to be stiff enough so that they would not spring under the weight of the load. In the same way the planking between them has to be stiff. If it is thin, they have to be pretty near together, and if it springs, it makes an unsightly face that nobody wants to build. I think it would be better to use 2-inch planks rather than 1-inch planks, and put the

ribs further apart. I think 2-inch is the ordinary thickness, but I have not any record of that. We have always used tongue and grooved lumber for the forms, because leakage lets some of the soft concrete out, and the tongue and groove gets battered after awhile, and after the stuff gets battered up too much, we have to replace it with new planking to keep the work up to standard quality. 5881

Questioned by Master.

I have not used the rabbited edge. It might do just as well. We have used another appliance sometimes, and that is to cut the plank on a slight bevel edge so that they patch on the inside edge only, and forms made up in that way, with the plank ordinarily dry, expand a little with the moisture of the concrete when it comes against them, and that works very well; we use that particularly 5882
on curved work. I have no objection to building this dam with all the blocks that existed in it, but I think there are more joints in it than have been used in the dams that have been recently built, and that are standard practice. I think it would be just as good if there were not quite as many, and I do not think it would make any appreciable difference in the cost. It would require a few more forms, but they could be used over and over, and I think there probably would be less work on them than the outside forms, although I am not sure about that. There were outside forms in building this dam as it is, but what I mean is in forming the blocks. I presume the blocks would be just alike, so that the form of one block would be moved up without any change, which isn't true of the outside forms, because the curvature varies as you go up, and the forms have to be rebuilt; then for the further reason that the blocks would not have to be held exactly to dimension. The outside has to be held exactly to dimension; on the inside form a little variation of a few inches more or less would not make any difference, so I think the interior form work would be a great deal cheaper than the outside form work. I have not figured on putting all these canals and little abutments on each joint. Some simple grooves would be used, and they are easily and inexpensively made. If I did, it probably 5883
would add to the cost of my form work, and to the total cost of my dam construction.

Mr. Schussler's idea, as I understand it, was to get the dam into a great many units, so that in case of a shrinkage, which you always have, and settlement, which you may have, that the movement would take place on these joints without rupturing the structure of the concrete itself. The Boonetown Dam, a dam somewhat larger than Crystal Springs Dam, was built monolithic; no joints were made in it at all. I think that is the largest dam built without joints. That cracked, due to the absence of joints, not in a way to interfere with the serviceability of the dam, but in a way to permit leakage, and to make that clear that it would have been very much better to have

built joints, every dam we had after that corresponding to it, as far as I know, has been built with the joints. I take care of these various stresses by a joint up and down the dam. Experience has not indicated that the horizontal joints are necessary. Vertical joints certainly are necessary.

5884 In the Ashokan Dam the railroad took care of the railroad construction. That was the Austin & Delaware Railroad. The branch line for use in hauling materials to the dam was taken care of, I think, by the contractor. In figuring my transportation handicap at Crystal Springs, I did not make any allowance for the cost of building this branch railroad. The cost of the side-track must be in the contractor's unit prices. That represented a couple of miles of very easy work, on practically a level course, carried by a total contract of something like $10,000,000. I did not make any allowance for that; I had no basis for making any allowance, and that would obviously be a very small amount. In the two miles I mean the connection between the heart of the work and the main line of the rail-
5885 road. At the Crystal Springs Dam I thought it would pay to build a track from the quarry to the dam, and I still think that would be the wisest way to take the broken stone in. That would not apply to the other material. That would be half a mile of track on this work, as against two miles on a $10,000,000 job on the Ashokan. I did not contemplate the use of that quarry down on the road to San Mateo, which now exists, because I suppose that the quarry above the dam is as good, and perhaps better rock, and it is more conveniently situated for the construction, and it is on the company's property.

CROSS EXAMINATION BY MR. SEARLS.

I do not know the total mileage of railroad constructed by the contractor at the Ashokan Dam. I do not question the statement in that report that there were about 20 miles of heavy rail laid on first-class ties.

5886 Every time the conditions have changed, and allowance has to be made for it, it weakens somewhat the foundation and reliability of an estimate, but I used for this purpose the best data that I had, and I applied the corrections in the ways that seemed perfectly fair to me. That is the best way that I had of getting at the proper cost of reproducing this dam.

I did not give the Spaulding Dam more consideration for this reason: I have visited the Spaulding Dam, and was told all about what has been done, and why they did it, and then I was given by Mr. Brittain a schedule of statistics and costs, but with the statement that it was confidential, and I have regarded that request binding, and I have only brought the Spaulding Dam into this discussion so far as I had it otherwise from open documents.

They hauled their gravel 30 miles on the main line of the S. P. 5887
I did not go down to the pit to see it. I saw some of the material up on the site, and I understood it was obtained very cheaply, and it was
almost ideal material for dam construction. I considered this Spauld- 5889
ing Dam simply in this way; to see if there was anything in the construction of it that was materially different, or that would upset any conclusion that I otherwise reached. I did not make any other use of it at all.

I find this note in relation to the Spaulding Dam "About $118,- 5890
000 for outlet works, excavation of foundation, old rails, and other expenses not part of masonry". Deducting that from the masonry cost leaves $7.10 per cubic yard; if we add a $2 handicap as between the two locations, it gives $9.10 for the corresponding masonry at Crystal Springs. If it were deducted from the direct costs, and the indirect costs were excluded, it would obviously be less. I would accept your statement that that would mean on the average, in the dam and the spillway, 75 cents per yard to deduct from my direct costs, which would make them $5.87 instead of $6.62. I have $1.30 as my indirect cost on that dam a yard, and that would be 19.6%. On the
showing before me, the indirect cost on the Spaulding Dam probably 5891
does not amount to as much as 40%.

The things that have to be done in building one dam are never just the things that have to be done in building another dam. If you start out by excluding for the dam on which you are making an estimate all the expenses on the other dam that would not be incurred on the dam for which you are making an estimate, and stopped there, you would be certain to get too low an estimate, because where there would be some items omitted, it is absolutely as certain as anything can be in human experience that you will have some other items that
will be greater. They are as likely to balance as to go up or down. If 5892
there are great inequalities, they can be taken into account, but ordinarily those things, within certain limits, are balanced. In order to get a basis for comparison between a dam where no railroad is going to be built, and another dam which is more or less comparable, and on which we consider that the indirect costs, exclusive of the railroad, are 13%, it would be fair, within certain limits, to exclude the very large items which have no application at all to the construction under contemplation.

Table of Spaulding costs introduced and marked "Defendants' 5893
Exhibit 118".

Mr. Hazen: Mr. Lawrence cut out a piece of masonry from the top of the dam, and quite a number of us went out to the Bryant Street yard, where it was, and inspected it. Mr. Dillman was with us, and he suggested the method of examining its specific gravity. His method was a perfectly good one, and the only reason we did not follow it was that we did not have, and could not readily get the means

to follow it out. We did weigh it, and measure its specific gravity by a method that I have used on many occasions. Beginning back as early as 1890 it was my duty to determine the specific gravity in substances, and to find the weight per cubic foot, and the voids, and I have had occasion to do that sort of work repeatedly from that time
5894 up to the present time. What we did was this: The block of concrete weighed 489½ pounds; we took a wooden tub and filled it 2/3 full of water, and put a piece of wire with a sharp point turning up, and then we put in water until it was precisely at the top of this hoop; that fixed very accurately the water level. Then with a block and tackle we lowered the concrete block into the tub, which raised the water in the tub; then we took out the water in the tub until it again came exactly to the top of the hoop. In other words, we took out an amount of water exactly equal in volume to that occupied by the block. The water that was taken out in that way was weighed in a tank, and weighed 202 pounds, which is 3.24 cubic feet, water weighing 62.4 pounds per cubic foot. The weight of the block amounted to 151 pounds per cubic foot on that basis. That is taking the concrete as it was in the dam. Mr. Lawrence drilled it out dry; that is, no water was used, so as not to wet it. It had only the moisture that was in it as it was in the dam. It seemed to me to be pretty dry. Of course, a little water was absorbed by the block when it was put into the water; that is a source of, I believe, small but not accurately known error. The block remained in the water some time after the experiment, and was afterwards taken out, and this morning it weighed 492 pounds, 2½ pounds more than it weighed before we began operations. There were present at that experiment Mr. Dillman, Mr. Dockweiler, Mr. Metcalf, and Mr. Greene. Mr. Dillman, I understand, does not assent to the correctness of this procedure. We are
5895 content to have the block go to any competent authority for any tests that may be desired. According to this test the weight was 151 pounds per cubic foot, and I think I said it would go between 148 and 155.

Mr. Metcalf: If the block were more porous, it would have weighed less per cubic foot; in other words, the more porous that had been, the greater would have been the weight per cubic foot of the material itself. To illustrate; if instead of that block of stone we had put in a tin can which was reasonably impervious, and had the same
5896 displacement, when we put it in the water would have risen to a certain level above your hoop gage. We would have taken off the water, weighed it, and have gotten the 202 pounds. Now, if we had opened the can so as to make it very impervious so the water could have filled the interior of the can, the displacement of the water in the tub would have been much less. In other words, a certain portion of that displaced water would now have filled the inside of the can. Therefore, we would have dipped out of the tub much less water than we did dip out, and we would have had much less than 202 pounds for that given

displacement. The less the displacement of water is the less is its specific gravity; in other words, we divide that 202 pounds by the weight of a cubic foot of water, 62.4 pounds, and in this case find that it was 3¼ cubic feet. If we had had less than 202 pounds, the displaced water would have been much less than three cubic feet, as for instance, 1 cubic foot or 2 cubic feet. Therefore, if the weight of the block had ranged 489½ pounds with the less cubic feet of displacement, owing to the greater poracity, the resulting weight per cubic foot would have been much greater, because in order to have found your weight per cubic foot you would have to divide 489 by 1 or 2, instead of 3¼.

Mr. Dillman: My general objection to this method is that as its purpose is to get at the weight of dry material put into this concrete, it is a very indirect method, and wrong in that respect. This method 5897
is vicious in this respect; the material there not only takes in the dry weight of the material, but also the amount of water in the concrete. I am not prepared to accept Mr. Hazen's statement that the water in this concrete is only 37 pounds per cubic yard. I think it is greatly in excess of that. If the block had been dry, and had been weighed in the air, and then weighed in the water, and its weight in the air dry had been divided by its loss of weight in the water, its specific gravity computation would have been correct. Concrete is a porous, absorbent material. The water not only of crystallization, but the entrained water held by the block mechanically, is a matter of doubt in my mind. The only way in which the specific gravity of this block can be determined accurately is to dry it out, weigh it in the air, and again submerged, and then the weight of the block divided by the loss of weight in water would give its specific gravity. The specific gravity is weight divided by true volume. In this case the weight is not right, because of the entrained water. Therefore, the specific gravity reached—2.42—is at least high; the actual specific gravity should be less than this apparent specific gravity, but this test showed an apparent specific gravity of 2.42.

Mr. Hazen: The specific gravity of this material is 3.10 before 5898
it is hydrated, and it is about 2.65 after it is hydrated.

Mr. Dillman: It is dry material when we are hauling it out there, and dry material simply increases its volume, and does not increase its weight, except by the amount of water.

Mr. Hazen: It increases its volume; it increases its weight about 8%.

Mr. Dillman: The difference in specific gravity between materials of this block, and the specific gravity of the block represents void; then the voids of the rock would be represented by 2.65, minus 2.42. As the 2.42 is high, and the 2.65 is low, this is less than the real void of this concrete. That is 8½% on those figures. This is low, and 5899
on proper investigation may amount to as much as 10%. The water entrained in crystallization, taking it at 1%, makes an addition to the

weight of the material of approximately 11%, which does not belong there; this 11% is represented by voids and entrained water. For this reason, and for the indirectness of the method, I shall reject anything based on this experiment last night.

Questioned by Mr. McCutchen.

Mr. Dillman: Some of the sand might be loaded on to the car immediately after it is washed, but the loading in the cars, and the transportation, and the drainage in the bins, would get rid of a great deal of this moisture before it got to the motor trucks. The Niles
5900 Sand & Gravel Co. gave me the weight of a sand-gravel mixture sufficient for a yard of finished concrete at 2,700 pounds. The Grant Gravel Co. gave me the same figures as 2,900 to 3,000 pounds, the 3,000 pounds being guaranteed by the company. The Rhodes-Jamison Co. gave me weights of similar material at 2,800 to 3,000 pounds. Eliminating the Niles Co.'s estimate as too low, and taking the average of the other two companies as right, we get 2,925 pounds as an average. Trautwine gives sand, pure quartz, rammed dry, as varying from 100 to 120 pounds per cubic foot, or from 2,700 to 3,240 pounds per cubic yard, the average of which is 2,970 pounds per cubic yard.

Trautwine says: "Natural sand consists of grains of different sizes, and weighs more per unit of volume than a sand sifted from it, and having grains of uniform size. Sharp sand with large and very small grains may weigh as much as 117 pounds per cubic foot". In his table of specific gravity of weights of gravel, he shows it to be the same as sand. This gravel grades from fine grades of sand up into coarse sand and then to fine gravel; there is not any definite line of demarcation between sand and gravel. I have considered that a mixture of gravel and sand would approximately be the weight of the sand of varying grains, which he says may weigh as much as 117 pounds; he fixes that as the maximum weight of that kind of material dry. This amounts to 3,159 pounds per cubic yard. Sands perfectly wet, and the voids filled with water, he gives at 118 to 120 pounds per cubic foot. Taking this evidence, the mixture will
5901 weigh from 2,700 to 3,160 pounds per cubic yard; it is not unfair to say that 3,000 pounds is an outside figure for this mixture. The cement is estimated at 500 pounds. It is considered as only occupying the interstices in this gravel-sand mixture, but it should a little more than do this, so that the resulting volume be a little greater. In this the sand-gravel mixture, and the cement addition are each outside figures, from the best evidence that I have, therefore, the materials of concrete, excluding the water, will weigh not to exceed 3,500 pounds per cubic yard dry. In my estimate the other day I considered a lower rate. My weights today are not low. 300 pounds additional weight of gravel and sand to each cubic yard at 80 cents per ton, which is an excessive figure per ton, adds 12 cents per cubic yard to the cost of the materials at San Mateo; hauling the 300

pounds at 20 cents a ton mile for the 4 miles adds another 12 cents, so the total addition, presuming that the material does weigh 3,500 pounds, it will be 24 cents per cubic yard. It costs no more for forms, bunkering, mixing and placing, than it did before, so that this 24 cents reduced the additional $1.04 that I added for profit to 80 cents per cubic yard. I see no reason for changing my figures.
My knowledge of what contractors will do work for is very definite 5902
in California, and especially in vicinities where the cost of materials and the haul of materials can be so exactly reached; in fact, the figure $6.90 is not especially the result of any analysis, but preceded the analysis in fact. I know more about the cost of complete concrete than I do about the different elements entering into it.

Questioned by Mr. Searls.

Mr. Dillman: I made my figure of $6.90 some time in the summer of 1914. This analysis that I have presented in evidence was originally started at the request of Mr. Steinhart, who said that in the trial of such cases it was usual to analyze these things, and that it would probably add greater weight to the evidence if I could analyze it. I made the analysis sometime in the summer of 1915.

Questioned by Mr. McCutchen. 5905

Mr. Dillman: I think that sample should be dried so as to expel all the moisture in it. This matter came up in some investigations I made at Oregon City some years ago. I had developed the fact that a different type of dam than a uniform section dam is more economical both in stability and in amount of concrete. In working this up, I wanted to know definitely the specific gravity of con- 5906
crete. Those experiments that I made there were the principal experiments I made in concrete. I cast several blocks of concrete. The aggregate was a broken stone which was Columbia basalt, and river gravel, and Columbia River sand. After a few weeks I tore off these forms, and broke them up with sledges to see what the concrete was. Two or three of those blocks I took to the boiler house and set between boilers, and left them to dry out for some time; then by weighing them in the air and in the water I got a very satisfactory specific gravity of those blocks. I didn't get any weights that showed a specific gravity of over 2 1/6; about 2 1/3 was the maximum of specific gravity I would get in dam construction. I used that in my dam analysis. This was 20 years or so ago, and there was a great deal of water in ordinary concrete as reported in the weights of concrete. This water would be an element of stability if it were not connected with the reservoir; if connected with the reservoir, it is an absolute detriment, and a diminution of the factor of safety of the structure, and for that reason, in my dam analysis I have never used over 2 1/3 as a specific gravity. I rather think that this block of concrete is more dense, and has a higher specific gravity as a whole, than that at Oregon City. I think possibly the rock is

5907 a little heavier, but whatever it is, it should be treated in that way. I propose to first take my piece of concrete and soak it, and let it take up water for two or three weeks, and then to weigh it in that condition, and then to dry it out. When it is reasonably dry I propose to weigh it, and then weigh it again submerged, and in that way get at the specific gravity of this specimen.

5908 If I were erecting a dam like this, I have no doubt I would tell my principal that he could make a yard of concrete out of the materials which those men in Alameda County told me you could make a yard out of. I do not know how much water there is in this concrete. It should weigh, according to my view, with the water that is in it, probably between 130 and 140 pounds. I don't know how much it should weigh, as I don't know how much water is in it.

Questioned by Mr. Metcalf.

Mr. Dillman: I know of nothing that is reported as weighing
5909 155 pounds to the cubic foot except cyclopean concrete. Taking 150 pounds as the weight, that times 27 cubic feet would give a weight per cubic yard of 4,050. A good gravel concrete, such as I have referred to in the authorities as weighing 145 to 155 pounds per cubic foot, contains a great deal of water, but I do not know how much. The statement that the concrete in place weighs 150 pounds to the cubic foot does not receive much credence in my mind. I don't
5910 think this particular concrete weighed 151 pounds to the cubic foot. As I explained this morning, the ratio of weight to volume, giving the specific gravity is wrong, because the weight is too much, thereby increasing the apparent specific gravity, and the volume is too little, because that concrete evidently was porous.

Mr. Metcalf: Assuming the aggregate weighed the same amount, the greater the porosity, the greater must be the specific gravity, or the greater the weight per cubic foot of the portion which is solid material.

5911 Questioned by Mr. McCutchen.

Mr. Dillman: I think concrete should weigh 135 pounds to the cubic foot. It might weigh 140, but not with the water in it. I think any weight in excess of 140 is the result of water. Trautwine says from 145 to 150.

5912 Mr. Hazen: In connection with the hauling of this material to the Crystal Springs Dam, I did not assume that the 1915 prices for hauling would be projected back to 1907, and it does not seem to me in this proceeding that it is a fair assumption that they should be. The art of motor trucking has developed very rapidly, and it is undoubtedly possible to haul material a great deal cheaper in 1915 than it was in 1907. I assume that you would haul by motor trucks, and hauling by motor trucks in the early days was much more expensive than it is now. I know that motor trucks were used in other places earlier than 1907, and if I were in error about that in the

earlier part of this period, that motor trucking was not possible, I would have to haul by wagon, and I am not prepared to say that that would be more or less expensive than by motor truck.

The Sunol filter galleries were actually constructed by beginning at the lower end and working up. That is the only way that I think anyone would think of constructing them. In digging a trench back into a deposit of that kind, all the water that now flows, and that is collected from this source, must be flown out through that trench, and in addition the extra water that must have come from draining it the first time. With that water flowing in the ditch it would not be possible to do that structure with the water flowing by. The water has to be taken care of. I have here a photograph of one of the pumps that was used to take the water out of the trench above the construction while the concrete was being placed. They used about 10 pumps. The water problem was a very difficult one. 5913 5914

Questioned by Mr. Greene.

I assumed 36 cents rebate out of theoretical 40 on cement sacks. That is more than has actually been obtained on the Calaveras work. It seems to be perhaps less at Calaveras, because the motor truck hauling, or hauling by team is hard on the sacks.

Mr. Dockweiler: I returned 35 out of 40.

Witness: Geo. L. Dillman. Dillman

CROSS EXAMINATION BY MR. MCCUTCHEN. 5915

The 18% in the estimate submitted modified in the estimate put in today to 13%, represents profit, contingencies, casualty insurance, accidents and incidents. The amount that is profit depends entirely on the management. If the contractor was sure of getting a 5% profit on a job, he would take this job very quickly. He would, of course, want all he could get.

Questioned by Master. 5916

A reasonable profit for a contractor on a job of this sort to estimate at first is 10 to 15 percent, but there is a leeway in all these prices, so that he might realize 25% on the figures I have given, and I do not doubt on letting this work you would get bids from responsible men to put this contract in way under my figures; possibly below $6. That is all a matter of opinion, and that is all I.

CROSS EXAMINATION BY MR. MCCUTCHEN.

I have made my figures on the assumption that a good contractor is entitled to make 10 or 15 percent profit on this work, and that would 5917
pay for the management. He would manage the contract himself, and

all the office men he would have would be a commissary man and a time-keeper. If he did not superintend it himself, he probably would have a superintendent, but if he were a wise contractor he would superintend the work himself. The contractor would probably sub-let part of this work, and that sub-contractor would expect to make a profit. I think on the hauling a sub-contractor on my figures would probably make a profit of 25%. I think he could sub-let that for 15 cents, and I know he could do it for 20 cents.

5918 Contingencies is not in management or profit, but the contingencies, whatever they were, would reduce the profits. I do not know what they would amount to. The 18% was originally gotten by adding to the probable costs $1 a yard for profit, contingencies, etc., and that came out to 6 cents, and I added the extra 4 cents to make it even money. If the corrections which I have made would apply, they will reduce that 18% to about 13%, which covers general overhead, profit, contingencies, accidents, etc.

I have allowed for accident insurance, which will cost less than 1% on the job, and would be based on the payroll. It would be less
5919 than 1% because the percentage on general construction is that much where a great deal of it is materials; there is no casualty insurance on materials. The complete payroll would bear a very large proportion to the entire cost. The railroad transportation is for labor. The contractor would not pay any insurance for the protection of employees of the railroad company that transports these materials, nor on the cement workers. The cement manufacturer pays it, and the railroad pays it on their men I suppose. By casualty insurance, I am talking about the payroll of the contractor himself. If he sublet a lot of this, the sub-contractor would stand his casualty insurance, and that would be part of the sub-contractor's corresponding
5920 overhead.

It would make a difference whether the sub-contractor paid that insurance, or the original contractor. The object of letting a subcontract would be for the purpose of having a man who is equipped and competent to carry on a part of the work at a less cost, or at less trouble than the principal contractor can do it for, and I do not know but what he would sub-let it all. The insurance on the subcontractors would come out of their percentage, and the insurance for the principal contractor would come out of his percentage. If the sub-contractor cannot do the work enough cheaper to pay the insurance and have a profit for himself, he would not get the subcontract.

Casualty insurance is rather an indefinite term. It depends entirely on how the work is handled, and on the management. The question of management is so much more important than the question of casualty insurance, and of other contingencies, that right there alone is a big profit or a big loss maybe. The Utah Construc-

tion Co., the largest contractor on this Coast, does not carry casualty
insurance. If I were doing this work, I would carry casualty insur- 5921
ance, because of small capital I would have to do that as a protec-
tion. It is like fire insurance; some real estate owners carry their
own fire insurance. The matter of carrying casualty insurance
would depend on the financial standing and capital of the contract-
ing company. If they thought it was cheaper to carry their own
risks than to pay the premiums, they would do it. I made no specific
allowance for casualty insurance, and I do not wish to be understood
as saying that no part of this 18% or 13%, as the case may be, is
for casualty insurance, because it is sufficient to cover it.

The actual expense of building this dam would be made up by
the cost of the materials at San Mateo, and of hauling materials 5922
from San Mateo to the dam, and the installation of the materials
in the dam. With reference to cement, there would be two elements
to consider one the cost at San Mateo, the other the hauling from
San Mateo to the dam. My figure of 20 cents per ton mile, which
is included in the cost of concrete, covers the transporting of the ce-
ment from San Mateo to the dam. That is 500 pounds of cement at
20 cents per ton mile, which is the 2,700 pounds I originally assumed
as the weight of the material, plus 500 pounds. Cement is $2.05 a
cubic yard at San Mateo. Gravel and sand $1.08 per cubic yard at
San Mateo. Hauling both of them $1.28 per cubic yard; that is at
20 cents per ton mile. I take the distance from San Mateo to the
dam as 4 miles. In making my concrete I have allowed 2,700 pounds 5923
of the mix, sand and gravel, according to the first estimate, and
3,000 pounds as modified this morning. I would take whatever made
the mix, 2,700 pounds, or 3,000 pounds, and that would have an
effect upon the quantity of sand and gravel which I would have to
buy. I would buy 3,000 pounds of sand and gravel per cubic yard
of mix, because I am satisfied that would be enough. If I were mis-
taken in that I would buy more, which would affect my costs, and
that would come out of my 18% profit.

This error, if it is an error, came into my estimate because of
my information from the Niles Gravel people that their sand and
gravel mix of 2,700 pounds would make a yard of concrete. I am a lit-
tle bit in doubt about that, and am willing to concede 300 pounds and
make it 3,000 pounds. From my investigation I am fully satisfied 5924
that 3,000 pounds of material of that kind will make a yard of
finished concrete in the Crystal Springs Dam. When you take a
yard of sand and gravel mixed and put it into a box, there are voids
in it. When you buy material over there, you buy it with a guar-
anteed weight, that is, that 3,000 pounds will make a yard of con-
crete, no matter how tamped. You buy sand and gravel by the ton,
which is determined by the fact that that weight of loose gravel is
larger than a cubic yard. I know that from my own experience, al-

though this particular mix I have never weighed, and that is the reason I have consulted the material men on this matter.

5925 If you took a box that held just a cubic yard of this mixture of sand and gravel and filled it without tamping it, it would probably weigh about 2,600 or 2,700 pounds. It is the tamping that would give the sand and gravel the additional weight of 300 or 400 pounds. You would not do the tamping until you had added the cement and water, and got it in place. It is tamped sand and gravel that weighs 2,700 pounds in the one case, and 3,000 in the other, that is guaranteed by the Grant Gravel Co. If I did not have the benefit of that guarantee, I would investigate it before I did order, and if I were going to take this contract, I would have this all guaranteed before I would even put in my bid. A ton of sand is usually sold by measurement on the car; there is usually a little excess of material to cover any possible errors in measurements, so that you get a full ton for every ton you are charged for, and a little more. You get it in just its natural state, and not tamped and compacted, but
5926 I have allowed something for compacting. That is, 300 or 400 pounds. I am as sure as it is possible to be that there was not a deficit of about 800 pounds of sand and gravel per yard of my concrete. If there is a deficit of that amount, my estimate would be a short estimate, and it might wipe out the profit and bring in a loss at the end of the concrete, if there was any possibility of that kind.

5927 Assuming that a cubic foot of concrete weighs 150 pounds, I do not know how much sand and gravel would be necessary to make it. I think that that was extraordinarily good concrete that was cut from the Crystal Springs Dam, and it is the best concrete that I would expect to get. I would expect to get a percentage of concrete not as good as that. I don't think that all the concrete in the Crystal Springs Dam would average as good as that, but it is all good con-
5928 crete. In my experience very little concrete is as good as that. It is my impression that the concrete work in Crystal Springs Dam is of A-1 quality. I do not know what the concensus of engineers is, but I have never heard anybody contend but what the concrete is of excellent construction. I propose to do as good work as that in this estimate, but if I had the designing and the supervision of the construction, there are a great many things which have added expense there which I would not do. I only propose to make a portion
5929 of the concrete as good as that. In this estimate I do, but I say if I had the designing and the supervision of the construction of that dam, I would not make it all of as good concrete as this. I think concrete containing 3,000 pounds of sand and gravel would make as good concrete as the sample which I saw last night, and I have no doubt about that.

I do not know of any sales in this market during the year 1913 that warrant me in assuming that you could get cement at San

Mateo at $1.60. That is just my general knowledge of commercial business, and the cement business in particular, that makes me believe that. In my opinion, the up-stream face of this dam should be impervious, and the down-stream face should be more impervious than the up-stream face. That principle was employed in the Spaulding Dam. That follows out good hydraulic principles. I have never 5930
seen the Spaulding Dam, but that principle was adopted in facing the Spaulding Dam with a cement-gun, and that was for the purpose of making the material on the upper face a less pervious material.

There is a hydraulic principle which underlies all hydraulic construction; it is that the construction shall be made with one water-tight surface, the balance of the structure to support that surface, and if that surface is not impervious, then it shall be the most nearly impervious surface, and the seepage and leakage getting through that surface must pass away without exerting pressure, or cutting velocity in doing so. That is the fundamental reason why the up-stream face of a dam should be the least pervious surface. That is why good construction today drains concrete structures from a little way down-stream from this face. That is the reason why pipes, where it is physically possible, should be calked on the inside; that is the reason why ships should be caulked on the outside. That is the reason why flumes are battened on the inside. 5931

The use of a cement gun for the facing of the Spaulding Dam made no difference in the poracity of the concrete below, but it increased the imperviousness of the up-stream face. I know of a concrete dam construction where my plan was employed. The up-stream face of my flood-gates at Stanislaus; the inside faces of my construction at Oregon City. If I had the designing of this structure this is what I would do. I didn't say that I had done this in my plans or in my ideas about the reconstruction of this dam. I have stated that in the reproduction of this dam I would use concrete of first-class quality right straight through, and of a density 5932
comparable with the concrete, and in doing so, it would rather serve to decrease than increase the value of that structure by reason of its being tight below the up-stream face.

Referring to an answer given to a question on page 5701 of the transcript; I think very likely that I may have confused the two ideas in that expression. 5933

Questioned by Master.

The $6.90 would build the dam as it is so far as its quality of concrete is concerned, and all I have said with respect to the available poracity of concrete in different parts of the dam is something that you need not consider.

CROSS EXAMINATION BY MR. MCCUTCHEN.

The down-stream portion of the dam serves to brace the up-stream portion, and while I have never analyzed it, I should say in a general way that the center of pressure lay well within the middle third, whether the reservoir was empty or full. The maximum thrust is at the bottom, and on the masonry the maximum crushing load is at the down-stream toe when the reservoir is full. The concrete there would be sufficiently compacted to carry the strains. The strains are not excessive in this dam, but are very light in compari-
5934 son with many dams. I would rather have the seepage that got down that far get away than be intercepted at that point, and that is always the way seepage is to be taken care of. I would take it away in drains. I would have a tunnel up pretty near to the face, and I would have galleries there for inspection. I would not have a tight dam at all, but would open it out. In a dam that I would build I would put the material which is less compacted where the
5935 greatest strain is, but it is not necessarily poorer material. It is almost as good for carrying a heavy load as the more compacted material.

My acquaintance in large masonry dams is not extensive, but the intake dam of the Great Western Power Co. was built with greater care as to tamping on the up-stream face than through the large portion of masonry. The principle is correct, but whether it has always been followed, I cannot say, and that is the reason why I put the poorest material in an earth dam on the down-stream face to allow drainage, so that if anything gets through the impervious core, it may get away without doing much damage. An earthen dam carries its load in a general way as a concrete structure carries its load. The concrete structure is narrower, and gets a greater pressure on the down-stream toe; on the earth dam the down-stream slopes support the impervious surface by its inertia. On the Great Western Dam they took more pains with the up-stream face than
5936 they did with the mass of masonry. They were careful to get a tight coat on the upper side, and the Great Western Dam is an example of the construction that I have advised here. The masonry in the lower part of the dam is of poorer quality than that in the upper part. I have seen it; there is less care in the tamping of the material and in the placing of plums. I was there three or four times
5937 when the dam was under construction. I got my information from the superintendent there, who said that they were putting just as good masonry in the lower part as in the upper part, but they did not tamp it as carefully. I do not know whether the plans provided for a less compacted material below than above. There were no specifications. They built it themselves.

The up-stream face of the Stanislaus Dam was made impervious
5938 in that way. The most particular part of the work to me would be

to make an impervious material for 10 feet from the upper face in this dam. All that is essential is to maintain the skin there. Do not understand me that there is any difference in the masonry in the two different parts of this dam. The material is all good, but it is a little more tamped, and a little more carefully placed for imperviousness at the up-stream face. When I speak of the up-stream face, I mean the upper 10 feet in thickness. I mean that the concrete in the lower part of this dam would be just as good as the concrete in the upper part. Concrete compacted beyond a certain 5939
amount has no special value for resisting pressure. I would not compact the material below the upper 10 feet, but I would try and make it tight in the upper feet. The compacted concrete would probably be a little better than the concrete not compacted. I mean by that it would be denser, and probably stand a slightly higher compressive strain. It might be stronger, but not necessarily so. I believe that compacting up to a certain point adds to the compressive strength of the concrete; that amount would be done at all parts of the dam; beyond that I would still further take pains with the up-stream face, because it would be a mistake to make the surface further down-stream less pervious than the up-stream face.

I would compact all parts of the concrete. The up-stream face 5940
would be compacted to a depth of about 10 feet. I would compact the material in the entire structure to a certain extent, the up-stream face more than the rest of the structure, but the up-stream face would be a small percentage of the whole. In speaking of the cyclopean structure in the Great Western System, I spoke of plums. I think it would be perfectly possible to use plums in the Crystal Springs work to the advantage of economy in the one case and profit in the other. There are places where you could get plums locally, but I am not certain about their quality. I have not made any special examination, but I would know that you could use small plums in the construction by taking the large gravel from the gravel pit and putting it in in the way that I have described. I would take the cobbles with the rest of the gravel, but use separate bins for loading bins at San Mateo, and storage bins at the dam for that material, then I would put the smaller cobbles through the mixer with the regular gravel mixed and cement, and the larger stones depending on their size into the dam direct. They would be taken to the dam direct instead of 5941
going to the mixer, put on fresh concrete, thoroughly wet the plums, and then cover with concrete. The putting on of the concrete would depend on what system I used to spread it. I would employ the system of putting my plums into the concrete with which I was most acquainted, the skip handled with derricks and rope ways. I would dump into the concrete from the skip. I have seen plums put in the concrete in that way, in the intake dam of the Great Western, a great many plums were put in there. They did not dump them from a great

height. They landed the skips, loosened the gate, or tipped the goose-neck and it was dumped gently as it was raised. The plums that were put in with the skip were what you could call man-handled rock, such as one man could handle, but they had also much larger plums that were derrick plums, and weighed 3 or 4 tons. I would operate my skip the way they operated at the Great Western Dam with ropeways and stiff-legged derricks. I would be very careful to have them not
5942 in contact with one another. I would spread the material on the dam with men handling the concrete that would separate them enough for that. They would do it by hand, they are not very large. It would not be a very slow operation, you don't have to move them very much. Most of them separate. The few that were in contact and were likely to make voids would be moved. If the work were carelessly done, some of them would be pretty well imbedded, and others might be right alongside of the first. I would empty part of the skip and keep some of them still in it. You could take out some of the load by hand
5943 if you wanted to, but I don't think you would do that. I think I would land the skip and then slip the gate or goose-neck and then hoist the skip. It would generally drop the rock in one place. They would probably be too close together, but the men on the work would separate the plums that were unloaded. The plums that would be moved would be on top of the mass very largely, and if they were too close together in the concrete, they would separate them with bars. All you need is to separate the plums a few inches. I have heard of plums being imbedded in concrete which were not carefully placed. This was done in placing the plums in my Oregon City structure in my Stanislaus head-gate. They were not separated several inches, but were separated enough so that there were no serious voids remaining, and that is all that is essential. If they were not separated, it would make a cave in there and the concrete would not run into it. The skips that I saw dumped up there at the intake dam, the der-
5944 rick would sometime drag the skip and scatter the plums that way. That is the small plums. The big plums were more carefully placed. These stiff legged derricks worked to one side pulled the skip as it went along and scattered these plums very nicely. The operation of the derrick is not automatic, but so far as the scattering it is automatic. I say derricks do that. I did not say that the cableway did it. The derricks do not pull straight overhead necessarily. The skip would be landed on the concrete, and then it would be loosened so that it would dump, and it could be pulled along as it was dumping, a very simple proposition. These skips are not tripped ordinarily. They have a door at the bottom that is raised. The operator would not close the door, he would see it scattered right. I could
5945 make this very good construction. I would do this for the sake of economy. I don't know that it would be economical, that would be a matter to be investigated as one of the operations that the manage-

ment would settle, and it might possibly be that in consulting with the engineer in charge of this work he would not want this done. If I was engineer of the work, I surely would recommend it. I would put 25 or 40 percent of that stuff, if it came out of the gravel, then I would get good work.

My information and belief is without having any opportunity to weigh plums that cyclopean masonry weighs a little more generally than other masonry. This is by reason of the plums, and that is the only kind of masonry that I have ever heard of as having 155 pounds weight to the cubic yard. The concrete would be mixed just as rich as it is now. That is where your saving would be. You would not need as much concrete. I don't know that in this case that the plums would weigh more than the concrete which they would displace. I would not estimate any added weight for that reason. I would not 5946
depend upon that to add any weight, because the plums would be small if they were taken from the gravel pit. These are small plums, they might be called currants.

I have rammed concrete according to what I considered it necessary for the job in hand. I have put concrete in without any ramming at all, and it stands up today and performs very good service. That is part of the experience which gives me my impression of the cost of the construction of this dam.

In the excavation of the Howard Cut I suppose I would take the material out with derricks. I would start in with teams and scrapers and accommodate myself to circumstances. When I got into greater depths, I might make a runway and take it all out with teams, if I could work them there. It would be dependent upon what material I encountered. You could work teams to start with. I don't know how far you could work with them. 50 cents a yard for excavation 5947
of trench for pipe laying includes an item for backfilling.

In the case of the Howard Cut trench, which is 40 feet deep, you would not have to handle the material 2 or 3 times if you knew how to work it. I would start in with teams. I don't know how long I would continue with them. I assume my trench would be the length of the cut. It would depend entirely on how the material came out whether I would use teams to the depth of 20 feet. I think that 50 cents would be about enough to do the work. I would have to use derricks for a small part of the material for the bottom of the trench. I don't know but what you could get a runway in there, but I did not 5948
settle that detail. I did not say that my figures were approximations and that they might be doubled of trebled through a careless or finicky supervision. I think that I said they could be increased by careless finicky supervision. There is a lot of difference between that and saying that they would be doubled through inefficient management. Finicky supervision means requirements that are in excess of the needs of the job. In making this analysis, I sort of made twins of my-

self. One of the twins was the engineer in charge having supervision of the construction, and the other is the manager of the contractors' force or the contractor. I would expect to have supervision on the
5949 work. This is a different line of work naturally than the manufacture of plates for your wrought iron pipe. I did not say that there would be no inspection on the pipe. I did not say that I would have supervision of the plates as they were manufactured. I said I would take the mill inspection, because to my belief and knowledge you cannot have an independent inspection of work at these steel mills. I did not intend to give the impression that inspection was not necessary. There is a mill inspection that as a purchaser you are entitled to. That went to the manufacture of the plates not to the fabrication of the pipe. I did not extend that lack of inspection to the fabrication of the pipe also.

EIGHTY-SECOND HEARING. DECEMBER 17, 1915.

Hazen

Witnesses: ALLEN HAZEN for Plaintiff.
DAVID DORWARD for Defendants.

CROSS EXAMINATION BY MR. SEARLS.

5950 The railroad that is in the auxiliary expense of the construction, of which the Spaulding Dam is one part, only a very small part of it was built by the Spaulding Dam. A great deal of that relates to other parts of their construction, and the distribution of that among different parts of the work, of which the Spaulding Dam is one part, is something which I did not attempt, and which does not seem to be necessary. One of the engineers of the Pacific Gas & Electric Co., with whom I talked this morning, and who heard my
5951 testimony, thought that I left out some items of expense, really chargeable to the Spaulding Dam, and on further analysis he told me that their cost was somewhat higher than the figures I mentioned. I think the reason that Mr. Brittain asked me to regard the figures as confidential was simply that the work had not been closed up, and he did not want any preliminary figures to be given
5952 out. I do not think there was anything secret about it. I was in the position that I did not want to overlook any available data, but the data did not seem to be advanced to a place where I could use it properly at the time I made my estimate.

Dorward

Witness: DAVID DORWARD for Defendants.

5952A

DIRECT EXAMINATION BY MR. SEARLS.

Since I testified last I have prepared, from original data, a list of the profits and percentages which the Risdon Iron Works actually

estimated on pipe work between the years 1907 and 1913. I was in charge of the majority of the estimates on contracts during those
years. In the estimates I made up I suggested to the president of 5952½
the company the profits that we ought to add, and he usually agreed to those profits, and they were put in as the profits. These figures
were taken from estimates we made during the period 1907 to 1910, 5953
and were the prices we submitted.

Questioned by Mr. McCutchen. 5954

The profit computed here is in every case on material as well 5955
as labor. These figures are the profit added to the cost of the fin- 5956
ished product, but not including a profit of 10% on the cost of the material when we buy the material ourselves.

DIRECT EXAMINATION BY MR. SEARLS.

The Arizona Power Co., January, 1908; the profits we estimated on ranged from 10 to 15%. The profit installing was the installing
of the pipe, which is the profit on the work alone. 5957

The Nordman Light & Power Co., 1907: The profit we figured was 16% on a 38 and 48 inch pipe.

San Joaquin Light & Power Co., 34 and 44 inch pipe, 1910, profit 15%; City of Tacoma, 16 to 72 inches diameter, 1911, 10% profit. We went out of business on the 30th of June, 1911. W. H. Metson, 36 to 48 inch pipe, 1908, a profit of 10%. J. E. Gallwey, 44 inch pipe, 1906, 17%. The same, 32 inch pipe, 1906, 13%. The same, 44 inch pipe, 1906, 12%. The same, 33 inch pipe, 1906, 15%. Stone & Webster, 60 inch to 90 inch pipe, 15%. The same, 24 to 96 inch, 1911, 15%. These jobs all involved material, except the Arizona Power Co., on which the estimate is for installing only. The San Joaquin Light & Power Co. did not involve installing. That was delivered on the cars at Friant, California. That bid involved
the fabrication of the pipe delivered on the cars, while in most of 5958
the other cases it involved the fabrication of the pipe and installing. A reasonable profit for a manufacturer of pipe, such as the Risdon Iron Works, to have received for fabricating and laying that pipe during the years 1907 to 1913 was not to exceed 15%. When I said
30 to 35 percent, at the last hearing, I had not given the matter any 5959
very serious consideration, but since then I have gone more thoroughly into it, and investigated what the probable profit would be.

The Master: I have been trying to follow this estimate in the form in which it appears on the face, and in my own figuring I notice a slight discrepancy. Take the Stone & Webster bid at Reno, the bid, including installation, $19,960, equals 15%; the bid delivered at Verdi, no installation, $13,360. That is the way the summary here reads. Now, by looking back at the base costs for those two respective matters, I noticed a slight discrepancy. The bid,

5960 including the installation, carried slightly more than 15%, according to my computation 15% on his base would be $19,605. The other one, where there was no installation, shows about as Mr. Hazen has figured, 16.1%.

Mr. McCutchen: That profit is calculated on the cost of the material, to which 10% was added before the profit was added. Here is a very good example of it in this Tacoma case. The cost of the material, including 10%, was $42,000; the labor was $20,362. If that labor were the total investment, or total amount involved, the price realized on that would be about 36%; that is to say, if it were resolved to conditions comparable to those obtained here. In the case of the Spring Valley, they did not get any profit on the investment, and my suggestion is that the conditions are not comparable to the conditions here.

5961 DIRECT EXAMINATION BY MR. SEARLS.

A table of computations as to the original cost of a 22-inch, and the reproduction of it, and the reproduction of the 16-inch submerged line, introduced in evidence and marked "Defendants' Exhibit 119".

The first part of this exhibit shows the length of the 22-inch pipe as originally laid. We, in conjunction with the Spring Valley inspector, measured each pipe as it was laid, and we both agreed on the amount, and a daily record was sent to the Risdon Iron Works,
5962 showing the amount of pipe laid. Those figures were taken directly from my record, which is in the form of a letter written by me, and approved by George Schussler.

Mr. Searls: Mr. Dorward finds a total of 696 lengths, and Mr. Hazen 714.

5963 Questioned by Mr. McCutchen.

The record does not show how much pipe was purchased for the job, and I do not know how much was purchased. These records show how much was transported to the pipe-laying barges.

5964 Questioned by Master.

We sent a report almost daily, except Sundays, to the Risdon Iron Works, telling them the number of each pipe as we laid it, and I got the prices; for instance, No. 325 was two pipes, that was one on each joint, and the pipe was laid down in two rows. I have gone through this and collected all that data, and found all told that it is 696 lengths.

Mr. Hazen: I think the average laying length of one pipe was 19 feet, and three-tenths of a foot space in addition to cover up the bell.

Mr. Dorward: I figured on the laying length as 19.3975; we measured from bell to bell when we laid it.

Questioned by Mr. McCutchen.

This was written on the pipe-laying barge, and mailed to the Risdon Iron Works. I was down there most of the time. I missed about a day and a half a week when I came into the works. When I was away, pipe was laid just the same. When I was not there, 5965
David Dorward, Jr., made the report.

Questioned by Mr. Searls.

David Dorward, Jr., is my son. He was the foreman in charge on the work. Mr. George Schussler was the chief inspector, and this is a copy of the report that he added to my letter. The purpose of these reports was to know the number of feet of pipe laid. The price was by the foot.

Questioned by Mr. Metcalf.

After the pipe was laid, the actual measurement was taken from the face of the bell to the face of the bell along the line of the pipe before it was slid off the barge.

Questioned by Mr. Searls.

The figures as to the cost in this sheet show the actual cost to the Risdon Iron Works, with the percentage added, but no profit. 5966
The item, cost of lead per foot in San Francisco plus 10%; the 10% covers over the cost of the lead; we figured it required so much lead to each joint, and the 10% was the profit. That was material brought into the works, and we added 10% to the cost of it when it came in. This was done on material we furnished ourselves. We did not add 10% on the other Spring Valley material.

Questioned by Mr. Greene.

When I wrote the line, the end of which is $55, I got that from my records of the work as it was done. One cast-iron bell we esti- 5967
mated at 1,000 pounds, and one cast-iron nipple as 500 pounds. The price finished was $55, and the freight was 75 cents per hundred pounds. This was made before I ever knew I was going to have any connection with this case.

Questioned by Mr. McCutchen.

These are my notes with reference to certain departments of the work with which I was in touch. The Risdon Iron Works books might have shown a different price, but that is the cost.

DIRECT EXAMINATION BY MR. SEARLS. 5968

We got prices from the different places where we wanted to get pipe manufactured. I obtained the data as to the cost from the records of contracts which we made with two companies in the East to supply these castings.

Questioned by Mr. McCutchen.

The Spring Valley had an inspector back there at the time these bells were made, but I do not remember that we had an inspector at the works. Mr. Geo. Field went East to make the con-

5969 tract. That expense appears in the overhead. Every year some of us went East in connection with various business matters, and that was never charged up directly to a job. It came in as a part of the overhead in getting out work. The Risdon Iron Works did not need to inspect that pipe; they left it to the Spring Valley.

Questioned by Master.

5970 I got the $55 from our office books. We had a record of it in the Risdon books to which I had access. The way I know the cost is that I had to approve the bills when they came for these castings. The actual source from which I wrote up the book which I have here was the Risdon Iron Works cost book. Generally on the job I did not see the books, but on the cost of these particular items, I did see them. I had access to the books for anything I wanted to see.

5971 Questioned by Mr. Searls.

We had time-keepers on the job, and took notes of the work as it was done in fitting on the castings on the pipe, and these notes were taken and worked down so much per foot.

Questioned by Master.

Our custom was to keep note books, and we noticed from day to day what amount of work was done on a certain job. We did not keep it on all jobs, but on certain jobs we did, in order to find the cost. These note books were not the office books.

DIRECT EXAMINATION BY MR. SEARLS.

We got the material costs, which we put in the other note books,
5972 from what we bought. The lead was taken from our store-room. All that stuff came into the store-room, and the store-keeper reports the amount of lead that was received for a job, and we always weigh the amount of lead required for each joint; we weighed that on the barge. The cost of the lead was made up in our estimate. Our estimate of cost here is 4⅜ cents per pound for the lead used on the 22-inch pipe. That came from figures given by the store-keeper, who reported to me, because I made up the estimate of the cost of the work.

Questioned by Master.

When I made up the estimate for the work, I had all these prices
5973 before me. I had the note books, and reports from the store-keeper, who acted as purchasing agent. When I wrote these matters down, I had this book to take the lengths from. That was our original estimate. The original note books are destroyed once that we get our records filed. The estimate which I had before me when I wrote down these figures was destroyed, too. The note books were de-
5974 stroyed, but the original estimate was taken. The figures in red ink were put in there at the time we made up the estimate, and it is in my writing. The bid was $10.90, and the $11.25 was the price paid.

Questioned by Mr. McCutchen. 5975

This is my estimate, made before the contract was let, but it is not from this that I made up my figures. I did not use that at all in making up my figures.

Questioned by Mr. Searls.

The cost of material was taken from that. Our storekeeper gave us a price on that lead. The bells and castings were stated figures of Kilbie Manufacturing Co., of Cleveland, and the Wheeling Foundry Co., of West Virginia.

Questioned by Mr. McCutchen.

I just happened to have this estimate among my papers in this book here. There were three barges used on the job. 5976

These were not the actual weights, but they show the costs. That 5977
is the estimated weight, and is the actual price we paid for it. I knew the actual weight at the time I made this record, but I did not put it in, because that would be changing my estimate. That is the original estimated cost, beginning with the line "unloading pipe" and ending with "testing and loading $4", and not the actual figures. We took the cost of the work and put it at so much per foot. 5978
The figure $22.42 is the original figure, and we got it from the record kept for the work. We took these items and divided them by the length of the pipe to get the cost per foot, and to get the actual cost of laying that pipe, we took the work at what it actually cost.

Questioned by Mr. Searls.

The figure on the actual cost of the pipe per foot includes the metal for the castings and the lead only, and not for the pipe. The cost per foot of $6.94 is taking all these items together. The figure $22.42 is taken from the actual work; that was the result of taking 5979
notes as to the actual work performed, and dividing it by the length of each pipe; each pipe cost that much to put the ends on it. The $22.42 is the price per length.

Questioned by Mr. McCutchen.

I got those figures from the notes we made while we were doing the work. I took these individual items here, but not the cost, and I put opposite the individual items the cost of doing the work as to that individual item, and that is the part I have not kept. This is not segregated; this is the cost of fitting ends, and the cost per foot.

Questioned by Mr. Searls.

We took each of these items, and according to the wages we 5980
paid for handling the pipe and laying it, averaged a little less than that, but they will all come out at this same item here 1.44. We took the net cost and added 50%. We took what the boat cost as the laying, and all these items, and added that percentage to it.

Questioned by Mr. McCutchen.

The item "Cost of 708 joints at works" means at the Risdon Iron Works, and the item "$54,459 cost of 708 joints of pipe at works" means what was paid for the casting, the lead, the rivets and labor. 708 lengths of pipe is the correct total number of pipes, but there were 40 pipes in the slough, which would leave 696 lengths submerged.

5981 Questioned by Mr. Searls.

I estimated that we would pay more for the castings than we did at that time in estimating the cost of reproducing these pipes, and then there would be the increased cost of labor, and the reduced hours of labor, which gave us the increased cost of the pipe per foot.

Questioned by Mr. McCutchen.

I would not say that that difference between the estimate and the actual length as I afterwards found it was due to the bells on
5982 the tube. The pipe varies in length. Coming from the factory, the tubes are not all of an exact length, they are allowed a variation of 5 or 6 inches in the length of the pipe. For instance, when they roll a pipe and cut it out, they do not want to cut off any more than the scrag ends and the bad parts; that would probably account for there being that many more lengths in the estimate.

Questioned by Mr. Searls.

I do not know whether 708 lengths were bought, but I am positive 696 were laid. We estimated that the casting would cost a little more. I think it was half a cent a pound more, and that the labor would cost half a cent a pound more. That accounts for the cost. In laying the pipe, there is a little difference of 10% in wages, but the improvements in the manner of laying the pipe would save that 10%. To offset the increased cost of casting, the lead, laying, etc., the manner of improvements would effect a saving of 10% in laying the pipe, and I have added 10% for labor, and subtracted 10% for improvements. I have charged one-half to my 22-inch pipe, and the other half is charged to the 16-inch, assuming they would
5983 be laid together. My profit on the original job was about 38.25%, and I figure 25% on reproduction, due to competition.

The figures at the bottom of page 3, as to the cost of dipping, and the assumed cost of galvanized metal, are taken from Mr. Dockweiler's figures. My estimate on the cost of dipping was very much lower than 22 cents per foot.

Mr. Hazen: The actual figure for the galvanized was 1½ cents per pound, which I think was something like $5.55 per foot. That
5984 is not for the pipe dipped. On the 16-inch line we estimated the weight of the bells and of the lead, which we took by carefully figuring the drawing of the bell and the lead, so that in the 16-inch pipe my weight was theoretically calculated. The bells and the

nipples are based on the same price per pound as the reproduction 5985
of the 22-inch. Based on the work we did on the 22-inch pipe, we estimated how much more we could do on the 16-inch, the pipe weighing very much less, and I have added half the cost of the barge outfit to the 16-inch pipe. I assumed that one pipe would be laid following the other.

Questioned by Master.

In getting the number of tubes on the 16-inch pipe, we assumed the length of the upper tube 18 feet and 9 inches. I assumed the tube to be the same length as the 22-inch, which we could easily get from the mills at that time. There is not so much difference between the ends of the pipe when they are laid, which increased the number of pipes required. The figures at the bottom of page 4 as to the assumed cost of pipe galvanized, were taken from Mr. Dockweiler's figures, as was also the cost of coating.

CROSS EXAMINATION BY MR. MCCUTCHEN. 5986

These cases that I have called attention to this morning, and on which I estimated profits, are all I could find in looking over what little data I have. The date of the first is 1906, and the last February, 1911. There are about 11 pieces of work in a period of about 6 years. The Risdon Iron Works did very little pipe work in that time. I also made estimates for the company of the profit which it should realize on other classes of work. I may have some of those estimates, but I did not carry them in this book that I have
prepared. It happened that I only carried into this book these 5987
Spring Valley costs, because there were certain jobs we were more interested in knowing the costs of than others.

I do not know as a fact that the books of the Risdon Iron Works were destroyed. It was generally understood that all these old books were destroyed. Mr. Joseph Rolph was the head bookkeeper at that time. Augustus Taylor was president at the time of the sale of the property, and is still living. Mr. Postelwaite was the super-
intendent of the works, and Henry Rogers was secretary. The books 5988
might be in existence now, but I have been given to understand that a great many of their old books were destroyed.

My estimate on the Tacoma job covered both the material and 5989
labor, and I added 10% to the cost of my material at the outset, which was the entire cost of the material landed at the foundry, including the cost at the mill in the East, railroad freight and cartage. When I came to figure my profit on that entire job, I allowed on material dead cost in San Francisco plus 10%. It shows here that the price of the material delivered was $1.95. To find the 10%
profit here, I take the cost and the bid. The bid was $81,500. The 5990
total bid on the finished weight is $52,936, and then there was the freight added to that, and the switching, which makes the cost

$74,111, and I added 10% to that. These were small jobs. It would take possibly 5 or 6 months from the time such an order was placed until the demand became payable.

In the case of the Spring Valley Water Co., the plates were supplied by the company, so that there was no 10% added to them,
5992 but the cost of making carried a good, fair profit. In the case of the San Joaquin Light & Power Co., I allowed 10% on the cost of material, and I figured on a profit of 15%. The material is 10%—$26,800, and the labor, $32,000. If I had computed that on labor alone, the profit would be 10%, or 15% on the total job. Labor and material, including the shipping, was $64,521, and I figured on nearly $9,000 profit.

Mr. Ellis: The percentage computed on the labor alone is somewhere near 27%.

Mr. Hazen: The profit of 15% is $9,678.

Mr. Ellis: In the Tacoma case, where the bid was $81,500, and
5993 the entire cost was $74,111, which gives a profit of $7,388, the labor was $20,362. That is 36 and a fraction percent.

CROSS EXAMINATION BY MR. MCCUTCHEN.

I do not know whether in the case of the Spring Valley work the profit was on labor alone or not. Very probably, if the Risdon people had furnished the plates, the profit would have been figured at much less, but they had a profit on the material, because they would have that much additional money coming to them. We would have seen that there was more money in the job if we had a profit
5994 on the material. If we had to supply the plates, we would aim at making a profit on the plates and also on the manufacturing, and the two would generally be considered together in making up the profit. If we only had the making, and not the supplying of the material, we would have quite a job in making that same amount of money. Getting a profit on manufacturing alone, we would have quite a difficult task in getting that amount to make up the profit
5995 on the plates. We could make that profit on the original pipe, but we could not make it on the reproduction, because competition would not allow it. I do not know what profit was made on the riveted pipe.

Questioned by Master.

I figured on a profit of 25% in determining the reproduction cost of the submarine pipes. It is a different class of work, because we had to consider the transportation by water, and the troubles we might run into in laying the pipes across the bay, therefore, I increased the profit.

CROSS EXAMINATION BY MR. MCCUTCHEN.

5996 In the case of the submarine pipe we require a little better percentage of profit, because in working in the water you are liable to have a little more trouble.

Questioned by Master.

The incidentals under the heading of laying pipe are meant to cover items that are unforeseen, both in materials and labor. I don't distinguish particularly between incidentals and contingencies. We 5997
took it that we would have to provide against these items, and when I add incidentals again $2,000, I mean the same thing, that we would be liable to other contingencies, some of them in connection with the work and some in connection with laying. My idea is that if I did that work again, in view of my experience on the previous job, I would have more definite costs. I would not allow so much for incidentals or contingencies, but I would still feel that I wanted 25%. Recently, in the reproduction, we knew very close to what the work would cost, providing against weather conditions, etc., and for that reason I added 25% as a reasonable profit in doing that work, and having to contend with weather conditions, etc.

Questioned by Mr. Searls. 5998

The Spring Valley Water Co. was very anxious to get the work put through at the very earliest possible moment, and that is where the bonus came in.

Questioned by Mr. McCutchen.

We did night work, and we spared no expense in putting the work through to accommodate the company. Referring to "Exhibit 119", the 50% overhead on labor, and the 10% for material, covers the contingencies. When I included 50% overhead on my shop costs, 5999
I covered contingencies, and that is the only allowance I make for that on shop work. The 50% covers the work of laying, and that item is in the addition of 1.44 and the first item. This is an addition which would not exceed 10% per lineal foot; that would cover it all. The items of $2,000 incidentals, contingencies $10,000, and incidentals again $3,000, were not considered at all in making up this reproduction. There are no items in this reproduction estimate that correspond to those three items of incidentals and contingencies aggregating $15,000.

Questioned by Master. 6000

We would not have to provide as much as that for incidentals and contingencies on a new job, for the reason that we know more about the game now than we did then; that 50% over the cost would actually take care of all the incidentals.

CROSS EXAMINATION BY MR. MCCUTCHEN.

I had no experience in submarine work before these two contracts were performed. When we laid the first line in 1887, the 16-inch, I was general foreman of the work, and had charge of getting out the pipe. I didn't have full charge of laying the pipe, but I was there very frequently, and I followed it up. I made up the cost of the 22-inch pipe, and then went to Honolulu, and while I was there

the contract was let. Mr. Field attended to that part of it, and Mr. Moore was then general superintendent of the work. The time between the laying of the first pipe and of the second, I think, was from 1887 to 1902. When we laid the second work we profited by
6001 the first. In doing the second work, I did not take into consideration the double contingencies and incidentals, but we allowed very liberally for incidentals and contingencies on the 22-inch pipe, because it was a very much heavier pipe, and there were more difficulties in handling it than in the first. I have allowed contingencies in reproduction in the 50%, believing that the 50% overhead would cover it. The 50% overhead in field work would come pretty near to $15,000.

Although the Risdon Iron Works closed in 1911, I have been in business on my own account all the time, and I know that I am bet-
6002 ter off now than when I was working for them. The other day, when I said the profit a foundry man should receive was 35%, I answered that without giving it due consideration, although I had been a partner in a manufacturing establishment for several years. There would not be many skilled men on this work. I would go along the
6003 waterfront and pick up a sailor gang to begin with. Those were the men on the barge. We had a considerable number of operatives there in addition, but they were not what you would class as highly skilled men. We had one machinist that attended to the engines, and we had an electric light engine which was operated by a sailor
6004 man. Sailors handled the engines that raised and lowered the pipe. The putting of the pipe together was not skilled work; it was simply a matter of putting one into the other and pouring a lead joint around it. After the lead was caulked, an ordinary man with a hammer and a drift staved it up. The Spring Valley had six men there pouring the lead and caulking, but I have not allowed for that in my estimate, because they were not required by the Risdon Iron Works. Mr. Schussler sent down some of his lead men that he had the utmost confidence in, saying it was an important job, and he wanted to be satisfied that his own men were doing that work; while his own men were doing that work, our men were standing idle,
6005 looking on. Mr. Schussler and I did not always agree. Our machinist and our boys, and one lead man, with the assistance of the sailor men would have done all the work that these six skilled men did that Mr. Schussler sent down.

There was nothing delicate about the work of pouring the lead and caulking. If there had been a leak in that pipe you never would have known it, because the pressure inside was greater than the pressure outside. I do not think that the pipe leaks badly now, or did at the time it was installed. I would not have expected the pipe
6006 to leak. It is scarcely possible that it would occur with that class of joint. I gave that job most of my time, and was there from the

commencement of the job to the finish, with the exception of the time that I came into the works. We made no test of it to see whether it was water-tight, but the Spring Valley may have done it. The only test I can remember was that the pipe was filled with 6007
water and submerged as it was being laid, and that was the only test. I do not know what the contract provided as to test, but I know we had to make a first-class job, satisfactory to the chief engineer of the Spring Valley Water Co., which we did.

It is a very remote possibility that there was a leak in the pipe after it was laid, but I have the 50% added to the labor of laying it. If there were a leak in it, you might have to take up one length at a cost of $25, or you might have to take up 50 lengths at a cost of $5,000, but we might not have to do the work all over again. There was not the slightest possibility that we would have 6008
to take it up, even though the work was done with the character of labor that we had down there. The men I had were capable of doing that work. Conditions in regard to labor are worse today than they were in 1913. Mr. Taft said at the San Francisco Exposition that Samuel Gompers had a greater lobby in Washington than the railroad companies or the steamship companies ever dared to have, and that that was in the interests of union labor. 6009

Questioned by Master.

The item, cost of complete joint fitted to one pipe and tested at works with lead, joint not poured, is not the testing that Mr. McCutchen has been talking about. He refers to the testing of the completed line. Each length was tested in the shop before it was shipped out, and the lead was not poured through until the pipe was being laid.

CROSS EXAMINATION BY MR. McCUTCHEN.

When I said the other day that labor was not more than 75% as efficient now as it was in previous years, I would go back to 1887, when we were not hampered by union labor rules. With a certain 6010
class of work we had a little bother with union labor in 1913. In 1910 and 1909 we were laying some work, and we didn't have a labor union man on the work. We had some sailor men to install the pipe, and our riveting was done with improved machinery by country boys. We would do the same today.

We have no shop here in town; we have agencies; we represent a large steel manufacturing company of Sharon, Pa. We have at the present time a contract at Martinez, amounting to about $140,000 for a lot of tanks we are putting up. We have union men and non-union men working on the job. We are not bound by labor union rules there, and would not be on a pipe job. 6011

If, having laid that pipe, I found there was a leak in it, I would get a diver and see what the extent of the leak was. If it was the

fault of the lead, I would try to caulk that under water, but I would be very much surprised if a leak were sprung in such a pipe line when laid. I do not know of any such leaks having been discovered,
6012 and have never heard anything of that kind. I did not take that into account when I made this estimate of reproduction.

ESTIMATE.

Approved by

For Whom, Spring Valley Water Works,

San Francisco, June 20th, 1901.

DESCRIPTION.

13200 feet—22″ O. D. Submarine Pipe.

(In lead pencil:)

"	Barges	used	— 1	Barge	91′ 6″	long	x 36′	Beam	decked	200.00	per month
"	"	"	— 1	"	66′ 0″	"	x 35′	"	"	150.00	" "
"	"	"	— 1	"	62′ 0″	"	x 32′	"	"	150.00	" "

MATERIAL:		Weight	Rate Per lb. Each	Amount
Summary				
2 lines 6600 feet each 22″ O. D. Tubing, S. V. W. W. furnishes pipe galvanized and coated with asphaltum.				
Each tube approx. 18 ft. long.				
" " " 18′ 8″ " laid.				
Cost of complete joint fitted to one pipe and tested at works with lead (joint not poured)				
Casting		1450	3c.	43.50
Lead		240	4⅜c.	10.50
Rivets		28	4c.	1.12
Labor (machine) including rivet holes				12.60
C. S. holes				6.20
Testing each pipe				3.00
Cost of complete joint				$76.92
6013 Cost of 708 joints on pipe at works				$54,459.00
Cost of 708 joints add to each pipe	$ 2.00			1,416.00
Patterns	225.00			
Tools for shop use	225.00			1,275.00
Testing machine	500.00			
Sundries	325.00			
2 Barges, 1—62′ x 30′; 1—68′ x 33′ (3 months)				1,800.00
1 Barge 105′ x 33′ or 1—90′ x 40′ (4 months)				1,200.00
6,700 feet 5″ Cir. Gal. Wire Rope (strand)			29c. ft.	1,943.00
8 Anchors, 1,500 lbs. ea., new 6½c., sell again 4c., 12,000			2½c.	300.00
7,150 lbs. Manila Rope			11½c.	822.00
6 Hand Capstans			$62.50	375.00

48 Sheave Blocks	155.00
Guide Pulleys and Tightener Screws	100.00
One Gasoline or Steam Launch, 3 months, at $20 per day	1,800.00
One 2-ton Hoist with Gypsies / One Fire Box Boiler } Use of	500.00
One Feed Pump, 1 Fire and Bilge Pump with Hose	100.00
Fitting up Barge, Chute and Shear Legs	1,600.00
Building, $600.00; furnishing building, $350.00	950.00
Setting Boiler and Machinery, $450.00; plans and sundries, $1,000.00	1,450.00
Laying Pipe:	
Rental of Tug	2,500.00

Labor:	
2 Riggers at $4.00	$ 8.00
6 Sailors at $2.50	15.00
2 Machinists at $4.00	8.00
4 Helpers at $2.00	8.00
4 Boys at $1.00	4.00
1 Cook at $2.00	2.00
19 men, labor per day, $45.00	

90 Days at $45.00 per Day	4,050.00
Board	2,000.00
Superintendence	1,200.00
Electric Light, Tools, etc.	1,500.00
Incidentals	3,000.00
Coal Oil, etc.	800.00
Add for Labor	10,000.00
	$ 95,295.00
Contingencies	10,000.00
	$105,295.00
Incidentals	2,000.00
	$107,295.00

Bid, $..................

(In Lead Pencil): $10.90

Kilby M. Co., Complete Castings Machined .... $60.00 each set
Wheeling M. & F. Co., Complete Castings Machined .... 50.00 " "
Cay Lay 8 Pipes per Day, 4 on each line.

Questioned by Master. 6013½

This estimate has nothing at all to do with my analysis of cost, or in the reproduction. This data I obtained from the actual work; this is what it cost us to do it, and was obtained from certain sheets or books, which are destroyed.

Questioned by Mr. McCutchen. 6014

This item of $21 taken from here corresponds to the $22.42. That is the work in the shop, and has nothing to do with the laying of the work. These are the men we had on the barge, and this is

what we paid them. We found that the average of that came to 96 cents, and added 50% to that to make the cost of the work in laying the pipe. The figures in red was a crew that we had; that would be an estimated crew. The actual cost of laying that pipe in 1907 to 1914 would be a little greater than it was when it was actually laid, but I would do it on a smaller margin of profit, and the improvements would also make a saving. The hours of labor would be practically the same out there, because we would be away from the influence of local affairs. We know from observation in
6015 laying the pipe, that we could improve the laying of it today.

Questioned by Master.

The increase of cost is .639 per foot, and then you reduce your profit, which I have estimated at 25% here.

CROSS EXAMINATION BY MR. MCCUTCHEN.

The men that would be on this work would not be skilled men. We would have a machinist and one lead man who would be sent from our shop, or picked up from the outside, and they would not be union men. These figures were not taken from the books of the Risdon Iron Works; they were from my note books.

Questioned by Mr. Searls.

6016 From your inventory I find that the number of straps, and the number of man-holes, were as shown here. I went into the cost of making these man-holes and straps in the shop and attaching them; taking the weight of the pipe from the 30¼ inch to the 54 9/32 inch, and taking the length and the total weight, I find the cost per pound is .3055. That was making a liberal allowance for making the bends in the work, and also attaching them.

Hazen

Witness: ALLEN HAZEN for Plaintiff.

DIRECT EXAMINATION BY MR. GREENE.

6017 Submarine pipes do leak frequently. The possibility of leakage is a very important element in considering what they are fairly worth. In this case the Risdon Iron Works guaranteed the tightness of these pipes, and 25% of the money which they received was held back for a considerable period until the tightness of the pipes was demonstrated. If the pipes had not been tight, I understand by the contract that the Risdon Iron Works would have had to make them tight, or forfeit at least this 25%. Submarine pipes frequently fail to be tight under similar contracts, and the contractors have been unable to get their money, because they could not make them
6018 tight. It is possible to caulk some small leaks, but generally speaking, a bell of this kind, full of lead, cannot be very well caulked. It can be corrected if it is one joint, by putting a split sleeve over it, and that is the common remedy. They make a steel sleeve with

flanges along each side that goes entirely over the joint, and then caulk it to the pipe on either side. That has been done at Portland and at Vancouver. We did it at Superior on an old line there that leaked. It has been commonly done. One joint of that kind may cost several thousand dollars. If there are many such joints that leak, ordinarily the line is abandoned. A great many submarines have been abandoned because they leaked. It is because of the likelihood of leakage and the great cost of repairing it in case of leakage that this work is regarded as extra hazardous. I think that a contractor ought to expect to make a much larger profit on it than on ordinary work, and I fully support Mr. Dorward on that proposition. I understand that the Risdon Iron Works have done very excellent work on all the Spring Valley pipe they ever handled, and I think 6019
it is worth every cent that it cost.

Mr. Dorward: We made tests in the shop, but I have not that estimate in this reproduction cost, and this reproduction estimate does not allow for any such tests.

Mr. Ellis: If we use the same layers as we did at Tabeaud, I 6020
figure that it would raise my figure from 50 cents to 51½ cents. In my computation of 50 cents I used the same layers and the same procedure that Mr. Schussler used, according to his testimony. I verified that by looking up page 718, volume 2 of Mr. Schussler's testimony, in which he said: ''We put on the layers not to exceed ''12 inches thick in the loose dump, and by the system of the wheels ''of the wagons cutting through them, as well as the 6,000 pound ''roller going over them repeatedly, we rolled those layers down to ''a thickness of not much over 9 inches.'' It was on that assumption I made my estimate of 50 cents; at Tabeaud the layers were much heavier and compacted.

(Certain corrections noted in the record). 6021-6022

EIGHTY-THIRD HEARING. JANUARY 20, 1916.

Witnesses: J. H. Dockweiler for Defendants.
Jerome Newman for Defendants.

(Master called attention of Counsel to the case of the City of New 6023
York vs. Wm. Sage, Jr., on the rule to be applied on condemnation cases, decided November 8, 1915.)

CROSS EXAMINATION BY MR. MCCUTCHEN. Dockweiler

The sand at San Mateo I have at 85 cents a yard, and my recol- 6024
lection is that I obtained the cost of that at Niles, and added the 6025
freight. I interviewed Mr. Ford, and he gave me 35 cents as the cost of sand. I do not recollect his telling me that he ever sold sand to

anybody for that amount during that period. I did not know that Mr. Ford was unfriendly to the company. I have not interviewed him with reference to Spring Valley affairs, excepting to obtain a record of the printed transcript in the case of Clough vs. the Spring Valley Water Co. I have never had any talk with Mr. Ford about organizing meetings in that locality against the Spring Valley Water Co.

6026 A little over three years ago there were some meetings held at Centerville, at which I spoke relative to water supply, and I think I had a conference with Mr. Chris Runkle, of Niles, who organized the meetings. Those meetings were brought about through the application of the City of San Francisco for the Hetch-Hetchy permit, and the Niles Cone people were exercised over the fact that the construction of its proposed works by the Spring Valley Water Co. would interfere with their water supply. I spoke at one of those meetings, and stated my views on the subject. At that time I was making an investigation of conditions of water supply on the Niles Cone, at the request of Percy V. Long, City Attorney.

6027 I was not making those addresses for the purpose of aiding the people over there, but I was stating to them the facts as to conditions over there. The object was to arouse that neighborhood to get behind the City of San Francisco, so that San Francisco could obtain the Hetch-Hetchy permit.

6028 (Counsel for Plaintiff read certain extracts from the report of Mr. Dockweiler's speech, as given at the meeting held at Centerville,
6029 and Mr. Dockweiler stated that the report as read is substantially correct.)

6030 During that time I was not in constant consultation with Mr. Ford, nor did I learn that he was unfriendly to the Spring Valley Water Co. I thought that he was friendly to the company, but within possibly the past year he has narrated to me little facts, which in his opinion, indicated to him that the company was not friendly to him. My occasion for seeing Mr. Ford within the past year was to borrow
6031 the transcript the second time, for the purpose of having copies made for the use of the City Attorney of San Francisco.

I did not make any inquiries to ascertain whether anybody had bought sand for 35 cents a yard in 1913. I did not buy any at that price during that year.

6032 I have not had occasion to investigate the price of cement as of
6033 today. The figure I assumed was the market price at which a shrewd purchasing agent with money back of him could have secured this cement as an average during the years in question, 1907 to 1913. The size of the order has something to do with it, and the quantity of cement used was one of the points that I considered. I do not recollect whether the City of Los Angeles, the State Highway Commission, or the Board of Harbor Commissioners, made purchases which fell

as low as 25,000 barrels in any one year. I do not know what figure quantity cut in those purchases. I do not know what the Spring Valley Company is paying for cement for Calaveras work. The prices they pay now would not concern me at all. I do not know how the market quotations in 1913 compared with those at the beginning of this year. I had no occasion to find out what the price of cement was in 1915.

Referring to Mr. Dockweiler's statement, as given at a former 6033-6037
hearing, that he was preparing a study for a water supply for the City of Richmond, in which study he expects to allow a very large percentage to cover contingencies: I have not made any figures as yet to cover the contingencies in that estimate. I would determine upon what allowance to make for contingencies when the data is finally assembled. When I finally come to make my figure, I will weigh the
nature of the data that I have, and apply, in my judgment, such a 6038
figure as will fix me safe, making the allowance for the omissions and uncertainties which a survey such as I have made in the case of the Spring Valley Water Co. will show. When I said I expected to allow a very large percentage, I did not have a figure in mind as a maximum, because I am investigating several routes. In the very nature of that there is such a range of uncertainty as to quantities that there is no parallel in making an estimate on such a work as against estimating the Spring Valley properties. I could not say what I meant by a very large percentage when I made that answer, and I could not define a very large percentage now, because each condition is a problem
unto itself. I could not say what might be the maximum. 6039

If this Spring Valley dam had not been constructed, and it had been determined to construct one like it, there would be no great uncertainty about it. An engineer would probably know the uncertainties to be encountered. There are uncertainties, or contingencies, and that is what you allow in taking an average price for performing same. You take, for instance, the output of labor. That is, on average conditions, and covers the uncertainties that experience has demonstrated. In estimating for new work, I would estimate contingencies very liberally, and by contingencies in that connection, I mean uncertainties as to the quantity of material that would go in; uncertain-
ties as to the quality. As to concrete construction, there is no uncer- 6040
tainty as to materials at all, because a man would investigate the nature of the material that he proposed to use. An engineer now would have before him the same physical conditions as the man had in 1913. There would be a contingency this way; a man might estimate that it would cost so much to get this rock out; that would be an estimate. After he had done it, knowing the exact cost, he would not have to figure on any contingency, because he would know what it cost him, but before he had done it, he would make a small allowance, and the contingency in that case possibly would be as to the

amount of the material that could be produced per unit of effort. He would fortify himself by making inquiries at adjoining quarries as to what they were handling; he would find out from quarrymen what rock could be quarried for, and having all of that data, if a quarryman told him, "I can do that for you for 60 cents", and the man was
6041 responsible, he would not have any contingencies, as he would say, "This man will supply me that rock for 60 cents, why allow contingencies". Generally, a quotation from these men can be relied upon as an outside figure. In getting up an estimate as to what his idea would be as to costs, he would allow an element which to his mind might represent an uncertainty or a contingency, and he might arrive then at the identical price that a contractor had given him.

Assuming that there is no dam at Crystal Springs, and that I were employed to design one, and did design a dam like the one that is there now, I would allow for contingencies just what I have allowed here in this estimate. As near as I recollect it, I testified in my direct examination that I allowed only that much for contingencies, because I knew in the light of experience just what the contingencies were.
6042 I did not necessarily make an allowance for contingencies in the light of the actual experience that was encountered in building the Crystal Springs Dam. I do say that that estimate is sufficient to build that dam on, weighing all the conditions that surround it. If no dam had been built, my allowance for contingencies would be just what I have given. I would say that a mixture of about 1.1 barrels of cement would be used; then I would say, allow a little bit extra, and I would use say a barrel and a quarter. In other words, I would put down 1.1, and I would then allow extra for contingencies, and allow a barrel and a quarter. In making the original estimate, you would go along this way: You would say, here is 1.1 barrels, that might make your mixture; then you would say, I will allow a little bit extra here, and after the final result, you have, say, a barrel and a quarter. That is exactly what the fact has proved here, because we have here every barrel that went into the job absolutely. So we have determined that mixture. That accounts for everything that was charged to it. It includes your loss, your waste, and the cement that was used incidental to the work.

6043 My item of contingencies covers each item. I do not know just what allowance I would make for cement. I allowed 2% for rock. Say a yard of rock would make a yard of cement, I allowed 2%. That did not go into my item of contingencies; I just included it there. It takes about a yard of rock to make a yard of that concrete in place; then I have actually used 1.02 yards. I have allowed 2% there. You may say that that covers contingencies, but that is in my unit price, and I have not worked it out under the heading of contingencies. I added 20 cents a yard for contingencies in the mixing and pouring of the cement, and that went into my unit price. I have not segregated

my contingencies. I gave so much for profit, which in my opinion was sufficient, and would cover contingencies; then I specifically allowed 20 cents a yard in the mixing and pouring for contingencies—in addition. Specifically set forth, apart from the 20 cents, there is a contin- 6044
gency included in that price in what I allow, say for contractor's profit. Then there are the contingencies of operation, which is covered by my unit prices.

Referring to my item of haul; you can hire an automobile for $25 a day, and I have allowed more than that.

I have not made any separate allowance for contingencies, refer- 6045
ring specifically to the item for concrete dam. I have given one specific allowance, which is a part of contingencies, in the 20 cents a yard for the mixing and placing; how much there is for contingencies in the balance of the estimate, I have not directly determined, but there is an allowance for contingencies, and in my opinion, ample. I have not figured it in the aggregate, and it is not possible, in the way I have given the figures, for anybody to determine what I have allowed for contingencies and uncertainties. This case and the Richmond case are entirely dissimilar. Under similar conditions I would 6046
estimate the same for Spring Valley as I would estimate for Richmond. When I get to Richmond, and I have detail surveys which enable me to determine my profile, and from that measure my quantities and determine my classifications, I will practically then use the same figures that I am using here for unit prices, which will include everything which I know, and which I will assume under the head of uncertainties. 6047

The fact that this work has been performed, and that I know something of the history of it, does not mean that there would be no contingencies or uncertainties in reproducing it. You can assume that under ideal conditions of fair weather a man would perform so much work. I have not used that, because, owing to uncertainties and contingencies surrounding all work, I have taken a much lower unit of output; in other words, more costly, and there I am unconsciously allowing for uncertainties and contingencies. A man might have to wait for material a little while. If his material is at hand, and he is ordinarily shoveling in concrete, he can give a rate of output double what I have assumed. I would not be justified in doing that, but when I say I have taken the rate I have, that covers the uncertainties of work, say the little losses of time. I have not counted on my force doing the work they could do if everything worked along smoothly. My output under that assumption would be very much higher. The output is based upon the contingencies and the hazards of the operations which they are to perform, and that is all taken into consideration in the rate of output. I have not made the determination as to the rate of output, because the output is 6048
based upon what men ordinarily perform on the work.

Referring to Exhibit 114, which says "direct labor, mixing and placing"—the item of 50 cents per yard includes 20 cents as contingencies. That is to say, if conditions were normal, the cost of that would be 30 cents. On that one operation I added over 60% for
6049 contingencies, which was simply my judgment. I had no mental attitude at all as to limitation; I merely put in the figure, which in my opinion was a justifiable and a necessary one.

Contingencies are covered in the units. For instance, on the wire—my haul is way high, and there is a contingency in there; there is a big allowance in there; I do not know, though, how much. I tried
6050 to play safe. I did not allow 60% in that case, as it was not necessary. In my opinion, I should not have allowed more for contingencies for the pouring than on the other elements of the work, because I had privately been assured by contractors what that work could be done for. Each operation is a problem unto itself, and I did allow more for contingencies on the pouring than I did on the other elements of the work. If, in the beginning, I would have taken 40 cents, and then added 10 cents, that would have been only 25%. This is merely a comparison of figures as they exist, and the percentage has no significance whatsoever. The addition, not considered as a percentage, is merely to round out a figure as the sum total for doing it. A man might have taken 20 cents, and then added enough to have brought it up to 50. The percentage would have had no sig-
6051 nificance whatever. I cannot give any reason for adding the 20 cents, except that it was after weighing all of the information I had, and to play safe I took that as a figure that should be allowed. All contingencies were not known, but the contingencies surrounding locations, quantities and classifications, in making an estimate ahead, you would not know. Going into it on an approximate estimate; by cross-sectioning it we find out the nature and amount of yardage removed. There you have a fact which in the beginning you have made a slip on. You might have estimated the slope steeper than you actually found it. Then again it may have slid in and added 20% for the yardage. Now, in this estimate, you are estimating the total yardage, while on a preliminary estimate you would say, well, I will estimate only 80% of the yardage. That is, your preliminary estimate may have included say 8,000 yards, but after it was built, slides have taken place, so that the measurement now shows 1,000 yards more. An engineer going in and looking at that work would say, there are 8,000 yards shown in the profile. Suppose I allow 20%. Then he would go up that much more and figure his unit price accordingly. The fact is, he would have done an injustice to the company, because the road now shows 10,000 yards, so you have the certainty of quantity there on which you have no contingency, and against the uncertainty of quantity that you had in the beginning.

There is no more uncertainty about the item of pouring than

about the item of forms. I have attempted to assign in the items of 6052
forms and pouring a figure which, in my opinion, when added to the total of these operations together, would produce a structure or the unit that we are working on. It is doubtless true that there may be little variations to the unit. That is, the actual cost of performing each operation, but in my opinion they will balance. One may be a little bit low, the other may be a little bit high. That is the very imperfection of the method, or the uncertainties that you are under that you cannot absolutely determine the cost of each individual operation, but by making a sum total of all the operations you can arrive at as close a figure as it is possible to get at under the conditions. You try to get as near as you can at the actual cost or charge of producing that operation. In the very nature of things you may miss it a little. The sum total will represent correctly your idea of the solution of the problem. There is uncertainty as to everything, but the degree where uncertainty differs from certitude would obviously differ in
every condition. The percentages of contingencies and uncertainties 6053
that an engineer adds depends entirely upon the degree of accuracy with which he works out the cost of each operation. For instance, a man might state, I will say that the cost of the material is so and so. I will allow a percentage that will cover every blessed item that I can conceive of that will enter into the thing. He may hit a close figure. His sum total may agree with that of an engineer who goes to work and works out each operation. There are no fixed rules by which a man makes his estimate. Each individual proceeds on his individual lines. The more varying their methods are, I think the better it will be. I don't recall having made a critical study of engineers' allowances for contingencies in addition to their estimated cost of individual items. I would have to know the conditions under which he was estimating and the nature of the data, and the knowledge that he possesses.

My costs on the Crystal Springs quarry are made up as follows: Labor of installing plant, 5 cents. There is an average contingency to that as to the performance of labor. It is not designated as a percentage. The percentage covering contingencies is taken as an average
performance. There is a crew of men installing that work. I take a 6054
crew that costs $136.50 a day, and the crew will install the quarry equipment in 60 days. That includes your contingencies and things that may happen in installing it.

The equipment totals $23,075. It comprises air drills, air compressor, guide derrick with its fittings, bull wheel, clam-shell bucket, 80 foot mast, 100 foot boom, triple drum and swing hoist, Smith Crusher, belt conveyor, surface booms, crusher motor, conveyor motor, water pipe, bins, trestle conveyor, crusher, lumber, guys, lead line, various other lines, cables of various kinds, wiring and contingencies, steel dump cars. I just chucked the contingencies in, and lumped it

with the wire at $800. That is my judgment as to what it would cost to wire that thing up. The wiring includes whatever wiring there is. Your motors, and whatever little uncertainties there are, so as to connect them up. I would have one crusher motor, one compressor motor, and one conveyor motor. The compressor motor would be 25 H.P., crusher motor 75 H.P., conveyor motor 30 H.P. I would have an air compressor that would weigh 4,000 lbs. I have not designated it by number but it cost f.o.b. San Francisco $463.50; to haul it out
6055 $14; $2.80 freight, and it will cost to land it on the job $480.30. I don't recollect how much air it will compress. It was selected though after consultation with the firms, and it was adequate to handle the number of drills we needed there. I have 4 drills, and don't expect to use more than 3. I would use the Sinker kind of drills. The unit cost is $72 each f.o.b. San Francisco. That is the standard price. I could get a power drill for $72. It would be the C.P.T. I have forgotten now what that stands for. I have operated burly drills from baby drills up to 2¾ inch cyclinder, and 3½ inches, and I have seen them larger than that. The drills that I propose would be operated by air. I would not use the compressed air for any other purpose that I can think of at the present time. I don't recollect the kind of drills I would use. I simply went down and got this quotation on drills for the work to be performed. I don't recollect that they are baby drills.

6056 I have allowed men to each drill as follows: A driller and chock tender. I don't know that any of these need valet service. I never had more than 2 men to a drill. I am somewhat familar with drills. If I was using a baby drill I would not give an assistant, but I have given 2 men to operate a drill. I don't recollect exactly as to whether they would be baby drills or not. I have allowed for a drill that requires 2 men. I have counted on keeping 3 drills all the time.

The air compressor plant is adequate to perform the operations. At that time this equipment would fill all the requirements. The requirements are that I should have a quarry that would produce on an average 500 yards per day output. The plant is designed to be operated at 750 cu. yrds. per 8-hour day. I would break that amount out with 3 machines. All of the rock would not be available. 100
6057 cubic yards of solid rock equals 130 cu. yds. of loose rock, and I allowed waste for tailings and washings 20 cu. yds. I call the waste, tailings and washings, and in washing there may be a little bit of dirt on the rock, but very little. For rock that might be unsuitable or too soft I allow 20 yards. I have told you that 100 yards of solid rock equals 130 cubic yards of loose rock. 20 yards would be lost; that is my estimate, and I would only have 110 cubic yards fit for crushing. My allowance for 4 burly drills was a determination arrived at after conversing with the seller of the drills, and you can figure that they will try and sell you all they can. I have heard that they

would exaggerate the performance of their work, but I have had experience in drill work. At least I am satisfied that the output I demanded of them would be readily complied with by this machinery. I have had experience with drills where the performance was like this in quarrying. I have not had personal experience, but I know the cost 6058
of quarrying, and I have seen them operating drills. I know the nature of the rock and the nature of the bank there. I don't know whether the drill sellers knew that there was not any possibility of selling me any drills, but I know the price they quoted was a fair one. The drill I would buy for $72 is marked "Sinker", C. P. T. Co. What that name stands for, I have forgotten. I don't recollect whether C. P. T. Co. was the name of the drill, or of the concern that gave the quotation. The assembling of the machinery for this equipment was made by Mr. English, who was conferring with me all the while. He had built a quarry, which I knew of from his statement. I have never installed any quarry myself, but I have made observations. I have general knowledge. I know the cost of quarrying around the bay. I have talked with quarrymen, and I have gotten information from them which is of a confidential nature, but which I have not used here, and which satisfies me that these figures are right. I am pretty hard 6059
to satisfy in the matter of figures.

The $800 item for wiring was merely an assumption, just wiring up those motors and stringing lines. It is an outside figure and a safe one, and will do the work. It will connect up your motors with your line. The line is right over the hill. It is probably 200 or 300 yards from you. You would probably use 3 wires from the power line to the motors; I think it is a three-phase system, but I am not an electrical expert. After that I don't know what I would do. That is up to an electrician. I just give an estimate that covers it. I don't pretend to be posted on electricity. That figure was arrived at after conference, and I am sure it was ample. I have conferred with these people, but I don't recollect who they were. I don't worry myself at all about the matter, because I made an allowance and let it go. 6060
I couldn't sit down and reason and worry myself over every item that way or I never would have got anywhere. I had to use a broad judgment, if I may so call it, after conferring with electricians. I had a man in my employ who was an electrical shark, and when he assured me that this figure was right I accepted it. I accepted the figure after forming a judgment that it was correct. As far as I recollect, I have given you all the data on this figure of $800 for wiring. That is $800 out of a total of $23,000. As far as I recollect, I have told you all I know. The figure of $800 I cannot segregate for wiring and contingencies.

The next item in the $23,000 is for air drills, cost $289. There are 4 of them. The air compressor cost $480.30, the fittings will cost $542.

6061 The fittings are for your guide derrick. There are two bull wheels that will cost $516.80. The large bull wheel would be at the base of the derrick that enables you to move the arm and swing your buckets into position. The derrick couldn't be a bull derrick unless it had the wheels. I am familiar with these. I went down to the manufacturer's place of business and saw it. I have seen a bull wheel installed and operated. I saw one worked in Los Angeles. The first one I saw was I think in 1894. You have to have two because you want 2 derricks so as to get the output. I don't exactly recall the output of one derrick, but I put in 2 so as to play safe. I don't know whether the second one would represent contingencies. I put it in the estimate as a safety. I know that 2 will suffice. The 2 will safely handle 750 yards a day. I don't recollect the rated capacity of each. You get information on these things from the manufacturer and the
6062 men who have used them. I don't recollect the maker of the derrick, but I can see that from the catalogue. There are about 300 makers.

The item of $1203.20 is for a clam-shell, 1 cu. yd., "G" bucket. There are 2 of them, $1203.20. This figure is an estimate from the manufacturer. I determined on their adequacy after conferring with various parties whom I don't recollect. I don't know from my own knowledge or experience that they were adequate. From observation I have a certainty, because the man who was preparing it and who was conferring with me had built and installed a quarry.

The item of $3250.80 is the total cost of 2 triple drum and swing
6063 hoists. They are operated with oil; with fuel. The fuel is a steam hose. It may be an electrical hose, I think it is. I don't recollect if there is any difference in cost between a steam hose and electrical hose of the same capacity. I don't state it here, but it must be electrically operated. Whatever it is, it has been allowed for. The inquiry I made was for the particular machinery that I propose to use, I don't recollect the data. This is a summary of the total equipment. The estimate here is for the hose as designated. It is a triple drum and swing hoist, and there are two of them. By a triple drum and swing hoist I mean exactly what the term indicates, 3 drums. Each hoist would have 3 drums. The swing means that the machines can turn
6064 around. You have a device—I don't know the technical name of it, but I know that this kind of a hoist can operate 3 ropes, and 3 will be necessary, and that they operate these lines from the bull wheel derrick that I have here. You use these hoists for the purpose of lifting the bucket, and handling rock, and swinging your rock over to your crusher plant. Your hoist does not swing. I have seen these hoists operated on various contractor's plants. I don't know just as to the particular size, but you can see them in any machinery outfit sales-room. I have seen a triple drum hoist on buildings. You will notice different drum hoists used in erecting steel work. If you want to use 4 lines you get 4 drums. It is necessary here to use 3

lines with this hoist, and hence you get a separate one for each line. I have seen hoists operating in a quarry. I don't recall where, but for this operation you need a hoist. All I know about the operation of a hoist is what somebody else has told me, but he was a man who had built it and was operating it, and was the best source of information.

The item of $3568 is for a great big Smith 7½ crusher. It weighs 6065
52,000 pounds. It will safely crush 750 yards of rock in 8 hours. I don't remember the size of it. It is a No. 7½. I suppose it is a gyratory crusher. Well, whatever it is it is a Smith 7½ crusher. I don't know whether it is a jaw or a gyratory, but it is the best crusher for the purpose. I don't recollect what power it would require to operate it, but I have a design for a crusher motor, 70 H.P., and that was figured at the time.

The next item is for a belt conveyor, $4290. I don't recollect what make it is. I think I have seen them operate in a quarry. I
don't recollect the particular quarry, but they have to have conveyors 6066
to distribute their materials. They are all automatic. The capacity is sufficient to handle 750 yards in 8 hours, and require 30 H.P. to operate them. I don't recollect the greatest height to which the material is to be lifted.

The plant was worked out by Mr. English and myself. Mr. English worked out all the details of it. I conferred with him all the while. He was two weeks in my office in preparing this Crystal Springs estimate from start to finish, as near as I can recollect.

The item of $2,019 is for the bins. They are rough Oregon pine. It takes 120,000 feet B.M. That is only for the lumber. You must remember that this is the cost of the material.

The item of $1198 is for several cables for various lines. The
total is $1198. Cable of that size has a unit cost of 17 cents. I got that 6067
from the quotations. 6300 feet, 17 cents. I don't recollect who the quotation came from. You get the ordinary cable for work of that nature. It would be a steel cable. You would not use an iron cable. I don't recollect how many strands it would be. You simply ask for a standard cable used in that kind of work. The men who supply that you get the quotations from. There are material men who are especially handling that kind of goods.

The item of $1,000 is for small tools. I wanted to be liberal on that. It consists of picks, shovels, sledge hammers, and things like that. You would have a pick to pick out the rock. A man might not want to handle it. It is an implement that I have seen used around a quarry, crowbars, sledge hammers. I don't know how many hammers you would use, but the $1,000 will certainly cover the tools. I didn't attempt to designate how many shovels, how many hammers, etc., but $1,000 will certainly cover a vast amount of small tools. I

don't know how I got the $1,000. I guess I was in a liberal humor.
6068 Probably I would have been justified in a closer study if I made a
list of every tool; probably I would have allowed as much as I have,
but I rounded it out and put it at $1,000. I got the quotations on
motors from some of the electrical houses; I have forgotten which.
You can buy good motors for that price. The item of $285 for motors
is merely the purchase price, and there is considerable contingencies
here for tools. Also for wiring. That is just the motor. Those prices
are safe. You are getting quotations. You can rest assured that when
you come to buy that material you can buy it at a less price. When
I was estimating the cost of this pumping station that I installed at
San Rafael I went and got quotations, and the bidders shaded those
considerably.

I cannot conceive of other material needed to carry on a quarry
of that kind. Everything is allowed for and most carefully gone over.
As to the burly drills, the price is for the Sinker drill alone. I pre-
sume the hose is included in the estimate, I don't recollect. The
6069 hose would convey the air from the end of your pipe to the drill. You
generally pipe your air from your compressor up as near as you can,
and then you attach a small line of wire woven hose to the end of
your pipe and lead it to your drill. I have not any hose in my esti-
mate, but it would be a small charge. The $1,000 for small tools will
cover that.

$18,000 is track around the quarry, cars. I have four 1 cu. yd.
steel dump cars to be used for hauling material. I figured I would
handle some of that by bull wheel derrick, and some of it I would
shovel into the cars. I would shovel some of it to keep my men busy.
There are cars used around a quarry, and I made an estimate for
6070 them. You would handle waste with them, some of the rock that
was not used; a man would pick up a poor piece and throw it into
his car; the fine debris or fine clay would work down on to the floor
of the quarry, and you haul that out to the dump in the cars.

6071 The next general item is the equipment, 14.4 cents; the cost per
cubic yard to quarry, and for crushed stone, and to deliver it into
the bins ready to dump it into auto trucks. Then I have an item,
labor on installing the plant, 5 cents. Labor on operating the plant,
30 cents. The 5 cents was the cost of installing the items which I
read this morning, which includes erecting and getting it ready to
run, a total of $890. That figure was worked up by myself in con-
junction with Mr. English. A crew is assumed to install this quarry
equipment in 60 days, and the crew costs $160.50 per day. I have not
segregated the cost of installing the separate items. I have just simply
estimated that 60 days will install the plant without going into the cost
of installing each individual item. In conferring with Mr. English,
we assumed 60 days, and he had had recent experience in installing

a plant. That portion of my statement is not based entirely on what 6072
Mr. English told me. I collaborated with him.

The installation of the compressor consists of putting it on a suitable concrete foundation. I allowed for that by rounding it off, and said, this sum will install it. I have not any separate allowance for material.

I have made an allowance of $8,190. That is what I call installing it, and will include the necessary materials for your foundations. I don't know how much there would be in the foundations. I didn't go into that at all.

The next general item is blasting, 10 cents a yard. Oils and waste, 1 cent. Stripping the quarry, 2½ cents.

In the blasting item I have included dynamite, black powder, fuse and caps. I would use both dynamite and black powder. It just depends. That is the estimate. I cannot tell, I don't exactly recall under what circumstances I would use dynamite or black powder, but that is an estimate which will loosen the rock and break it up. If you should run across a ledge that is very hard, you would spring your hole with a little dynamite. Dynamite 6073
action is very quick. Then you would fill it with black powder which has a very slow movement and gives you a great lifting force. It loosens large masses. I don't know that you would run across rock that was very hard. The black powder does not make very much difference. I have made an assumption that for every 100 yards it would take 20 pounds of dynamite, and 125 pounds of black powder, 24 feet of fuse, and 2 caps. That figures out at $10.18. Divide that by 110 yards of material suitable for crushing, which 100 yards which are loosened will produce, and it gives me a figure of 9.3 which I have rounded off to 10 cents. From an examination of that country from the surface, I would say that I feel sure as to the conditions that are to be encountered. I have allowed 2 caps for 100 yards. I would drill two holes in order to throw out 120 yards. I am going to discharge some dynamite first, which would take a cap. For the black powder you would ignite with a fuse; you don't need a cap. The holes would be 16 feet deep. I would use 24 feet of fuse, and it would be unnecessary to run it to the 6074
bottom of the holes. There is some room taken by the charge. I use 12 feet of fuse to a hole. I would have 4 feet of dynamite. The powder comes in sticks, roughly, like candles. You just slit the sides of them, put them in, and tamp them with a wooden tamper so as to break them, and you put in your cartridge in the top stick. You attach to the end of the fuse the cap which fits right over the end of the fuse. You press that cap into the stick of dynamite which you are going to put in to the very topmost part of this layer or stick, and then you put your tamping on top of that. You slit your fuse. I didn't figure the number of sticks of dynamite in each

hole. As a result of the blast in these two holes I will throw out 130 yards, which will make 110 yards fit for crushing, allowing a loss of 20 yards for tailings and the process of washing. I have seen a quarry in which 130 yards of material was broken out by
6075 drilling 2 holes. I can size up the bank, any bank of that nature. If I were to get a space there of 25 or 30 feet, I could probably break out more. That is an average. I have seen several quarries, but don't exactly recall where. I have seen some quarries in this city and on the Oakland side of the Bay, where they use powder. I saw a quarry at the top of Telegraph Hill where Gray Brothers were stopped from shooting. I have seen their quarry out here in the Mission. I don't know just what place in the Mission it is located. You have a bank there, and I should say that the rock is pretty near the same as the Crystal Springs. It is more of a chert here. I think they call it radiant aerial chert. Rock similar to that you see in Golden Gate Park. The rock in Crystal Springs is not similar to that in Golden Gate Park. This is an altered sandstone; it is very hard, but it is extremely brittle; if you drop a piece it breaks.

One man will drill 50 feet in 8 hours, using a Chicago pneumatic, a one-man drill. I have averaged him to do that, but he will do more. I have heard of records double and treble of that, in reading the literature on the subject. This is an easy material to drill
6076 through. It breaks very easily. I have read of a man drilling 60 feet in 8 hours from the records of drilling. I can't recall, but I know that it was a straight figure. You work right down. Most of these drill holes will be put down vertically. It is easier to put a hole down vertically than it is horizontally. In this condition, that is true. If it is an incline hole, and it is a self-cleanser, you will drill more, but if it is horizontal, or anything below horizontal, the hole is not self-cleansing, but I don't see that it will make much difference in the speed; anyhow, this figure is safe. I don't recall that I have ever seen it done, but in going around these quarries I have noted the output. I cannot pin it to any one thing, but that is
6077 an impression I have got which I know is correct. I didn't bother about the air that it will take to operate one of these drills.

The next item is stripping quarry, 2½ cents. I allowed a sum of $4,000 for that, and divided it by 150,000 yards. The average amount of material to be moved would be 2½ or 2 feet in depth. I made the computation of the amount of material at the time, but I haven't it here. That quarry would not go over more than a couple of acres, that is about $2,000 an acre. You would just clear off enough. You would remove it with plows and scrapers, and would not go down to any nicety. If any dirt fell in and you didn't make a clean job of it, you would have your pit men there to take it out. I have provided cars and men that will handle that. That

is one of the incidentals. Suppose your quarry gets a face of 30 feet for every 30 feet in depth, and every single foot you have to remove, if it is 3 feet, say it would be one-tenth roughly, that would be easily handled. As you get nearer the top, I don't think the overburden will be that deep. In fact, I recall now that when I went down and noted it, I think I was convinced that this item was a little bit large, but I didn't change it. In other words, an inspection of the quarry after it was opened showed there was not an average depth of the soil that I have figured. I don't recollect what the figure was, but I know I have that impression.

In the next item I allowed 10% contingencies, and 3% for liabilities. The total of the items I have heretofore given you figure up to 65.9 cents. Then I allowed 8.6 cents for contingencies, which 6078
was 10%. Then I added 3% for liabilities. That rounded off to about 75 cents per yard. That is my allowance for rock after quarrying, and delivered in the bins.

For contingencies I estimated that my figuring was close enough in detail so that anything that happened would be covered by this 10%, because I had covered everything that I could think of, and this covers the contingencies for this particular operation on the quarry.

I would just dig a little bit of a hole on the hill, and face it in the direction away from the quarry to store my powder in. This magazine would be built of boards, or might be built of stone. It might cost you about $100 if you cared to do that. I would put on a board door. I would put on an iron door. The 10% would cover that, supposing it would cost $300.

The next general item; we have already taken up the sand. I use 1.2 cubic yards of rock. I estimated that the rock is worth 6079
$1.02 a yard delivered in the bin at the foot of the elevator hopper. That is the item of $1.04 in the estimate. The difference between the 75 cents per yard and the $1.02 is 27 cents, which represents my estimate of cost of hauling that material, loading and unloading it from an automatic dump wagon. That is from an auto truck. It is 27 cents for a little over half a mile haul. That is 75 cents a yard plus 27 cents, making $1.02 a yard delivered at the site of the work. Then I have cement 1.24 barrels, at $2.10 at the site of the work. That gives me $2.61 for that item. Then I have forms 8 cents. I have something in the 8 cents for contingencies. It is not so stated, but it covers the average work of men handling it. The nature of the contingencies and the amount is not specifically set forth, but it would cover an average performance of labor. The 8 cents includes both labor and material for the forms. There would be 456,000 feet of lumber used. That is No. 3 common, surfaced one side. That is $12.09, and makes $5,513. The $12.09 is the price delivered at the dam. As to the lumber, there is such a large quantity of it, and I will

specify that I can take a pretty good load, and say I buy the lumber from the ship's tackle, I load it on cars and bring it to Millbrae where I have a storage yard, and I deliver the material from there. You surface the lumber on one side at your yard at Millbrae. That
6080 is a very cheap operation. I have that worked out. You put in a little bit of a device. I think surfacing one side is about $1, if I recollect right, I know that that is sort of a list price. The plant for surfacing is a little bit of a cheap proposition that you put in. It is the same as a portable device that carpenters and contractors bring around, and is a very cheap, crude affair. I don't remember what it costs. In talking to a mill man, he said that for that amount of lumber your labor item will cover your plant. I mean the allowance I made for surfacing work. I allowed $1 per thousand.

At ship's tackle, the average price for lumber is $3 per thousand less than pile price. Anybody can buy lumber at ship's tackle. I conferred with lumber men on that, and they stated that men who had the money could buy it. For form lumber the average price that has prevailed during the last five years on this material is $7.50
6081 per thousand ship's tackle. Information received from the Hoffman Lumber Co., 145 Berry St., City, May 18, 1914, form lumber No. 3 common. I have a yard price of $10. That evidently was the better grade. The difference between yard price and ship's tackle on form lumber No. 3 is $2.50. No. 3 lumber is ordinarily used for concrete forms. It is the poorest grade. It will hold so long as the knot will not fly out. The knots frequently fall out of No. 3 lumber, but they can put a little cleat over that. I have seen some of the company's concrete work. I don't know if they used No. 3 lumber, but that would not necessarily be conclusive on anyone. I have figured for contractors, and I know their work. I cannot find any reference to where I have worked out the method of handling the lumber after I receive it at ship's tackle. I would take it from there to Millbrae
6082 on the ordinary device used by lumbermen. The device is a little buggy; I don't know the technical name for it. When it is loaded they hitch a horse to it and take the lumber to where they want to stack it. I am not counting on having the lumber stacked there. You would have to arrange it in some sort of a pile on the dock. My operation was to get it aboard the cars as quickly as I could with the least number of operations and then send it to Millbrae. Lumber weighs about 3½ pounds—about 1½ tons to the thousand feet. This would not be seasoned lumber. It would be very green I think. A thousand feet of green lumber might weigh more than 1½ tons, and undoubtedly does. I have all of that down in my notes, but I cannot find them now. Whatever the weight is, I have allowed for it. I would get it on the cars, take it to Millbrae, and there it would be unloaded and surfaced on one side. In handling
6083 that stuff I have forgotten now just how I would get it, but I fig-

ured out the cheapest way of handling it. You will note that there is pretty nearly $5 a thousand between my ship's tackle and delivery at the dam. I don't know who has bought lumber at $7 a thousand for form purposes, but when I get a quotation from a reputable firm like that, I don't have to go outside of that. I think this quotation gave me an average price for the past five years, which would have run from about 1909 up. I received the quotation in 1914, the date I read you. If, in my experience I had never heard of anybody who actually bought lumber at that price, it would not necessarily assert that it is not so. I made inquiries, and wanted to know if I was in the market for so much lumber what I could obtain it for, and they stated if you can use enough so that you can get a rate at ship's tackle or cargo lots, you can buy it. You are practically on a footing with these lumber people, because 6084
there are a lot of tramps in the lumber business.

In the course of this work it would be necessary to take care of some water. I would let it run out through a culvert that is built there. I would build that big tunnel and drive that through. It would be just the same size as it is now. I don't recall the size, but it is something like 7 feet. I would expect floods. If any came, you could let them run right over the top of the dam. It would not do any harm. The aim would be to build that in two seasons, and not do much work in the rainy season. I would not let the water run over the top of the dam if I could help it, but it would not do any harm. It might do $100 worth of damage, loosen some forms or something, and you would probably have to remove a little silt, but it is practically negligable. It is good construction to allow water to flow over concrete work of that kind. If the concrete sets three 6085
days it is in perfect shape to stand the water running over. The tunnel would be built as a precautionary measure. It takes care of your water in a measure. What it cannot carry you allow to run over the dam. I assume that the 7 foot tunnel would not take care of the water, and that the flood would overflow the dam while in course of construction. I didn't see what it did during the actual construction of the dam. It was building two or three seasons. I assumed that they did let it flow over the top. I put the worst construction on it. I am assuming that water can run over the top of the dam. There is no other place for it to go. If you have reservoir capacity sufficient, obviously it cannot overflow. I don't see anything that would justify you in building a conduit of sufficient size to prevent the water flowing over the dam. If the material is of 6086
such nature that it cannot stand the flow of water, you better tear it out and put in something that can. I expect to take two seasons in building the dam. You can have the biggest flood that ever came down there going over it, and it would not do any harm. If a man is going to lay off, he would pile his blocks in such a way that he

would have a dish or a gap in the center of the dam when he is going to quit for the season. He would have it built up on both sides, and leave a wall, and let the water flow through there and through
6087 the tunnel. I counted on that. That is merely building one block in preference to another. My impression is that on the Roosevelt Dam, after it was built a certain height, the floods went over it. I have only seen photographs of the Roosevelt Dam. My impression is that somewhere or other there was a statement I have seen where water actually flowed over part of the Roosevelt Dam, but whether it did or not is immaterial. I say that water can flow over it, and I have assumed that it will flow over it. I have never seen a dam in the course of construction where water was allowed to flow over it.

I used the Southern Pacific on cement as supporting data for my
6088 figures. That price throws some light on the price at which cement could be bought in this market. The Southern Pacific I think touches at a number of points where cement mills are located. I think it has a line down through Santa Cruz, and one down near Suisun or Benecia, and I think they have a line into the Cowell Cement Plant. I guess there are cement plants in Utah on the line of the Southern Pacific. My price in San Francisco is $1.57 for
6089 cement.

With reference to hauling, the distance from San Mateo to the top of the dam is four miles. I think we measured it with a speedometer. We followed the route that a team would take from the location of the warehouse at San Mateo. I don't recollect where the commercial tracks are at San Mateo; wherever we went to though, it was a spot where I judged we could establish a warehouse. I don't recollect where the warehouses are at San Mateo, but I looked over things there. I don't recollect if I went to the track where cars loaded with that kind of material are placed, but I selected a place where evidently there was a siding, which in my opinion would be a good site for a warehouse. I don't know if I asked the warehouse people whether it was available for that purpose, but I know as a matter of fact that the railroad will put in a siding for you at any place where they can get the business. I don't remember whether the location of the warehouse was toward the dam or away from it. I know I took a 4-mile haul for my material
6090 from San Mateo. If the distance to the top of the dam were five miles, you would have to change my figures in proportion.

(Statement by Mr. McCutchen to the effect that Mr. Lawrence has been instructed to make accurate measurements from the tracks at San Mateo to the bottom and top of Crystal Springs Dam.)

6091 I assumed that the concrete would be poured by an apparatus, some of which may be patented, but there are devices which I understand are being used which are not patented. I don't know what

the names of them are. There are quite a number of them. I didn't
go into the matter at all, but just talked with one of the men, and
he gave the idea of the prices; what they would pour it for, paying
for a royalty. This man was the chief engineer of the G. Y. Sys-
tem of Los Angeles. I can't recall his name. I had it on a draw-
ing that he furnished me for the layout of the plant. I have not 6092
that drawing here. In fact, he made a trip with me to the dam. He
did not say that he ever built a dam, but he poured yards of this
concrete. There is not any difference between building a dam and
pouring concrete into a form 100 feet wide or 1 foot wide. I state
that as an engineer that is making it for the object for which it is to be
used, recognizing the use to which it is to be put. From my own
inspection I know this apparatus to be successful; I have seen them
pour in Los Angeles, and I think at the Stanford Apartments, here
in this city, at California and Powell, a man named Sly poured con-
crete there. Those are thin walls in that building; reinforced con-
crete. Extreme care must be used in that work because the walls
are so thin. I don't recollect what royalties Sly paid. I don't think
a royalty of 2½ cents a yard would be too much. That price of 50
cents a yard there is so staggeringly high as against what that man
informed me he could put it in for and would do it for, plus royalty,
that I state that 50 cents will cover any royalty charged. The man
was the chief engineer representing the company. He didn't give
me an exact figure as to what the royalty would be. I think we 6093
talked around 3 and 4 cents. He said, you can use this as a kind
of a figure, and it certainly won't be above that. That is my rec-
ollection. It is within the possibilities that the apparatus would
not work satisfactorily. I have seen the apparatus used in Los
Angeles. They are pouring the great Field Museum in Chicago
with it now. You can see photographs of it. This is an ideal spot
for it. There is not much moving around to do. You put it up and
you have large masses to pour with it. I have allowed a grade of
30%. The G. Y. man figured only on a 20% grade. If I remember
right, I am sure that the material will pour. They gave me a design
for a plant that would pour 1,000 yards a day with only 18 men.
I have the drawing in my office. I don't know whether that man
owned the patent, or whether he might be infringing. I know that
he stated to me that he was connected with some concern in Los
Angeles that was erecting buildings. Other than that I don't know.
I didn't go into the legal status of it. I have gone into the use of
this apparatus, and I assumed that it could be used, and that the
price I am giving you would cover it. In the light of information
given me by him, my price is away safe. I cannot figure on aban-
doning the apparatus. It is not at all experimental. I cannot 6094
account for the fact that it has not been used on dams being built
in this country. I think that method was used in building the Wash-

ington Light & Power Co.'s plant in Spokane. I was so informed by this engineer. I presume the Spaulding Dam was built by up-to-date engineers. I don't know of any other concrete dams built in this State since the Spaulding Dam. The reason the apparatus was not used on the Spaulding Dam was because they had to shove in so much material and it had so many boulders in it that they could not carry it. They had the wash gravel. They used a modification by using wooden troughs. They wanted to get through in such a rush, and they used the pit run, and it had lots of large boulders, and would not permit of them pouring it. At Crystal Springs it is of an entirely different mixture. The system used at Spaulding differs from the G. Y. System because they did not have
6094½ grade enough to go to the top when the dam came up to a certain height, and then they ran the material by gravity as far as they could. Then they lifted it by a tower and ran an incline from that tower; from the foot of the first incline they hoisted it into a second tower, and deposited it. It was deposited mostly by gravity. The plums that went in were put in by derricks. I examined the site where the derricks were. I saw the loose rock which had been shot down. They intended to utilize that rock, but they could not put in plums fast enough to work in with the concrete. In other words, they were pouring so much each day. The G. Y. man told me probably a year and a half ago that these appliances had been used in Washington. I think I heard of these appliances as far back as 1912. I think that the electric light plant in Long Beach was poured in about 1912. I have counted on using this apparatus as far back as 1907. I stated as an average that I would use this system between 1907 and 1914. I have a catalogue here dated Septem-
6095 ber, 1911, which shows views of the plant which was used to build the Gerald Apartments, in Los Angeles, and to build the Sweet Water Dam, gravity tower and cable; and showing the government warehouse under construction at Fort Mason, using the gravity G. & Y. System; the construction of the Edison Electric Co.'s plant, at Long Beach, Cal.; it shows the construction work on the Barlow Building, in Los Angeles. They had built at that time. This shows the thing actually working. There is such a large margin between what they told me the work could be done for and my estimate, that you could allow for throwing away part of the tower and cables, and run it down the chutes. I didn't include throwing away part of the tower and cables. I want to call your attention to this cata-
6096 logue where they show the site of the Washington Power Dam under construction, in Washington, being the largest overflow dam in the world, 200 feet high. I am informed by these people that they had built this dam. The dam had not been built at the date of this publication. It just shows the views. I understand, though, that the dam has been built. I have been very anxious to get the cost

of that work. I wrote to the Public Service Commission, at Olympia, Wash., for the detail cost, and they told me that it was in course of preparation, and until the case had been decided by the Commission, the valuation of this property being one of the points under consideration, the data could not be disclosed. The average output which I have assumed allows further interruptions in this apparatus. I have an operating crew there, you will recollect, that maintains this plant. It is true that I don't know who owns the device. There are several of them. I have seen devices similar to this pouring 6097
concrete. I have seen some of those working in Los Angeles. I have never seen one used on a dam, but there was one used on the Sweet Water. There is an illustration of it here. It was used by Arthur Brent, whom I think was the contractor on that. I cannot state whether it was a success or a failure. I have seen the Sweet Water Dam since the addition was put on it. I do not know whether the appliance was used on any of the work, or whether it was abandoned before the work was completed. The photograph of the plant shows it installed and at work. The work was quite a thin piece, and the 6098
cost of the plant and installation would amount up and give you quite a high unit cost. After it was erected though, it is obvious that the larger the output, and the longer you use it, the cheaper unit price you would get. I think the cost of installing was away out of proportion to the amount of yardage to be used. I should judge from the site here that it would not be a very costly one, but still it would be costing you relatively. That is, the cost of the equipment would cut quite an item in what I would think would be a comparatively small yardage.

RE-DIRECT EXAMINATION BY MR. SEARLS.

Mr. Lawrence and I took up the matter of wastage of materials, and adjusted it. My computation did not quite reach the yardage claimed by the company. I said, let it go, that will cover some errors of omission. The yardage given is in excess of what the drawings and measurements will show. In the Crystal Springs Dam 6099
I made computations from measurements. My computations did not reach the volume of yardage claimed by the company. We discussed it at considerable length, and went over and checked the drawings. I said, well, I will agree to it and will accept it, and it will probably cover something that we have overlooked, some contingency. I think I made that statement. In getting at quantities, for instance, figuring the number of brick per cubic foot, we took 6100
such a unit as would allow for waste. I have not proved that, but I am explaining how we got at the schedule of quantities.

The only object that I had in speaking to the farmers at Niles was to induce these people to give me access to their well readings, and to gather data for the use of the City of San Francisco for its

campaign in Washington. If Mr. McCutchen will read further from some of those speeches when someone asked me the question whether I thought the riparian rights belonged to the company, I told him that everything they paid for they were entitled to. I tried to take an absolutely neutral position in the matter, stating the facts as I view them. I had no animus then, nor have I now against the Spring Valley Water Co.

Newman Witness: JEROME NEWMAN for Defendants.

6101 CROSS EXAMINATION BY MR. MCCUTCHEN.

The total cost of the Crystal Springs Dam, according to my estimate, would be roughly $1,000,000. The total cost of the machinery provided for doing the work I estimated at $17,500. The structures are $27,000, making a total of practically $45,000. I cannot say that I know of any piece of work which cost $1,000,000 where the equipment did not cost more than $45,000, but I do know of one case where a job cost a million and a quarter on which the equipment cost roughly about $80,000. The reason it went so high on that particular job was that the contractors, on account of some error in drawing their specifications, were crowded for time and made an effort to finish the job in contract time, and for that reason spent about $35,000 or $40,000 more than they would have spent if they had been given twice as much time as had been given them. That was some harbor construction on two large piers on which the equipment, on account of the character of the work, would be considerably more expensive per yard of concrete than at the dam con-
6102 struction. I have never made any effort to ascertain the percentage of equipment cost in dam construction. I made no allowance in my estimate of the Crystal Springs cost for a cableway. The dam could be built in that way, but there are other methods. It strikes me that one method is as good as another. I contemplated the use of a trestle and running cars, concrete cars, across the trestle, depositing the concrete in movable hoppers connected with pipes as nearly vertical as possible, and depositing the concrete from these pipes into the dam. Derricks are not necessary. A derrick would ordinarily lift the concrete skips from one level to another, and place them exactly where required. The flexible pipe I assumed would make derricks unnecessary. If you built your trestle level with the bunkers, the maximum fall would be 140 feet from the top of the trestle to the bottom of the gorge. I would drop my concrete 140 feet. That decidedly would be good construction, in my opinion. I have seen concrete dropped 75 feet which came out at the bottom just as good as it was at the top. Possibly there is a height beyond

which it would be unsafe to drop concrete. I don't think 140 feet would be that height. I think you could drop it 140 feet, and besides that, if it were considered impracticable to drop it from 6103
that height, an elevator could be built alongside the mixer, and a trestle built into the operations, a story halfway down, say 70 feet, and then gradually built up as the dam progressed until it reached a full height of 140 feet. We had no trouble whatever in dropping concrete 75 feet, and didn't notice any difference. The danger in dropping concrete from a great height is the segregation of the material. There is a point, of course, where there would be danger, but dropping it 140 feet, it would only take a matter of four or five seconds to reach the bottom, and in that time I don't think any segregation could take place to amount to anything. The segregation would take place in the form. The impact at the bottom would tend to establish the mix again to a certain extent. We would not rely on the impact to re-establish the mix. We would rely on no segregation taking place during the drop. I assumed auto trucks from the quarry to the bunker. There would have to be tracks to carry the rocks to the crusher. The rock would be delivered from the crusher into bunkers, and from bunkers into the trucks. I didn't go into the matter of quarrying tools and equip- 6104
ment. I just took it in a general way from my knowledge of what it cost to crush rock, based on figures that prevailed on the waterfront and in San Francisco for the last seven years. That varies. In some cases rock was delivered from the quarry on barges at 75 cents a yard. The prevailing price in San Francisco for the last four years has been anywhere from $1.15 to $1.25 a yard at the bunker. Three or four years ago in quantities as large as would be needed for this job there would be a reduction of probably 10 to 15 cents a yard. The way I arrived at my figure of 71 cents, or 88 cents rather, less the haul would be 71 cents, was to figure on a price of 1.10 for that quantity, which would be about right for the period under consideration, estimating a profit of 20% to the man who crushed the rock, and adding 20 cents a yard for carrying across the bay from the quarry. These are segregations which I made with a knowledge of handling quarries, and I reach the amount of 71 cents a yard. It is 88 cents here, but that includes hauling half a mile from the bunker to the mixer, leaving a net cost of the crushed rock in the bunker of 71 cents. I have bunkering at the dam 4 cents. My allowance is 67 cents only. My method of getting at these various items which make up the 67 cents was principally by hasty observations at the various quarries around the bay, and inquiring here and there as I got the opportunity. To a certain extent it is impossible for a man to get anything like accurate 6105
figures from observing operations in quarries, but he can ask questions. If he had a force of inspectors at each quarry observing op-

erations and keeping track of the costs, he could work up the figures himself. I did not do that. I got an idea of the cost of the work from the men in charge of the work. These quarries were the Healy-Tibbits Quarry in San Francisco, the one at McNear's Point, and one of the Daniel Contracting Co., also at McNear's Point. There is another crushed rock quarry at Point Richmond, belonging to the San Francisco Quarries Co. The rock at these places was practically all Franciscan Sandstone. The rock looked to me to be practically identical with that at Crystal Springs. My estimate includes waste, which varies from 8% to 12%. The waste consists of screenings principally, and rock that is crushed either too large or
6106 too small. It is not in any case due to the character of the rock.

I went to Crystal Springs from San Mateo. The only quarry I noticed was about half a mile north of the dam. Assuming the crusher on the San Mateo Road where there was a large amount of rock turned out unsuitable for concrete, it would not necessarily follow that a repetition of those conditions would exist at Crystal Springs. I have not allowed for any waste of that kind. I assumed that every cubic foot of rock broken out, if not too fine or too coarse, would be available for concrete, and the 12% waste would be only on account of the fact that it would be too fine or too large. Quite often seams and deposits are met with in quarries which are not suitable for concrete. I would not expect to repeat an experience of that kind in the Crystal Springs quarry. That experience was in two of the four quarries which I have spoken of. Practically in all four of these quarries, if you get a ledge of this blue altered sandstone, that material is homogenous as long as the ledge lasts; the surface rock is more or less discolored, and you get under the ground and strike the ledge which is practically uniform. The depth of the
6107 solid layer underground varies according to the top soil, and at McNear's Point Quarry have two or three feet of dirt. The Daniel Quarry half a mile north has anywhere from 5 to 15 or 20 feet of dirt above it. After you get down to solid rock you do not strike to any great extent material not suitable for concrete. It is very seldom that is the case in the ledge. The Daniel Quarry, and one of the quarries near Point Richmond, you find the ledges broken by frost deposits. Between the ledges there are these deposits of inferior material. They are usually pretty wide. They are broken out in the operation of quarrying. They are a detriment. I should say that this experience would not be met with in my inspection of
6108 the face of the Crystal Springs Quarry. My inspection would not enable me to determine with absolute accuracy whether such inferior places would be encountered, but with some accuracy. That is to say from my experience with these sandstone ledges along the bay, knowing the character of each of those four quarries, I should say that this quarry would be liable not to show those inferior spots.

The Crystal Springs Quarry resembles the McNear Point Quarry more than any of the others. It differs from the Point Richmond Quarries wherein there is less dirt on top for one thing. If the water were out of the reservoirs, it would have to have the same height as the San Francisco Quarry at McNear's Point has. I do not know 6109
the waste in the Point Richmond Quarries.

The figures under the head of "crushed rock" down to the line "hauling a half a mile 17 cents" was obtained from others.

The lumber I assumed would be used in the forms would be rough Oregon pine. My idea is that I should use No. 1 common. I cannot say that the use of No. 3 lumber would be very poor construction. It is possible to get a grade of No. 3 that might be good enough to serve the purpose, and then again it might not. In my experience I like to use as good lumber as I can get for that particular purpose, because in the long run I think it is cheaper. There is less work, less liability of knot holes, and of breakage, and to a certain extent, less liability of having to do the work over. Of course, as I say, it is possible to get No. 3 lumber to serve the purpose. If you watch your lumber and see that you are furnished with the best possible No. 3 to pick out. It would depend on conditions. 6110

Questioned by Master.

I mean it is possible if you are lucky. Otherwise, you would have to take it as it comes.

CROSS EXAMINATION BY MR. MCCUTCHEN.

I cannot say that the use of No. 3 as you take it off the ship for forms in work of this kind would be very poor construction, because there are differences of opinion among engineers. My opinion is that I would use No. 1 common. At the same time another man may be justified under conditions as he meets them to use No. 3. I would use inch lumber. Inch and a quarter is better. That is inch and a half to inch and a quarter size. I have handled very little No. 3 lumber. Of course, we don't do the work ourselves. Contractors do it. I have not seen any handled on waterfront work. We will permit the contractors to do anything they please as long as they furnish us good concrete. I assumed inch and a quarter lumber. For the studs I would use timber for the uprights. I counted on 2 x 6 green lumber. We usually figure that at 40 pounds per cubic foot, which is 3 1-3 pounds 6111
per foot board measure. For that reason I figured freight to San Mateo at 1 and 2-3 tons to the thousand feet. The rate is 60 cents per ton. The trucks from San Mateo to the dam provided by me would haul, I think, 7 tons to the load, which is about 4,000 feet. You could get any lengths from 8 feet to anything you can get. Your studs would be sufficiently close to permit the use of anything in multiples of 2 feet. The length of the timbers would affect the quantity hauled on the trucks. You could get a lumber truck with a tractor if you got long

lumber instead of putting it on to a truck. The cost would not be increased, and you could haul considerably longer lumber than you
6112 could on an auto truck. I do not know anything about the conditions which prevailed from 1907 to 1913 as to the possibility of taking very long timbers around those curves.

I do not know when the use of tractors was begun. I think they were in general use in 1913, but I am not sure. They would be permitted over county roads now. I don't know of any rule against them on the State Highway. They make no more impression on the asphalt pavement than auto trucks. My price for auto trucks was $25
6113 a day. The price for hauling different materials reduced to a ton mile basis varies. It is 21¼ cents per ton mile for cement, 17 cents per ton mile for sand and gravel, and I think 17 cents per ton mile for lumber, if I am not mistaken. I figured on a haul of 4 miles. I figured on 1 2/3 tons per thousand feet of lumber. My haul is $1.19. The distance is 4 miles. The load is 1 2/3. Four times 1 2/3 is 6 2/3. Divide 6 2/3 and you get something between 17 and 18.

EIGHTY-FOURTH HEARING. JANUARY 21, 1916.

Witnesses: JEROME NEWMAN for Defendants.
GEO. L. DILLMAN for Defendants.
J. H. DOCKWEILER for Defendants.

6114 CROSS EXAMINATION BY MR. MCCUTCHEN.

I did not allow for equipment in the way of machinery. It would all be done by hand labor, and possibly they might have a derrick for
6115 the handling of forms. I did not count on stripping the forms off the front and back of the dam.

I made an allowance of $1.40 at the mill for cement, which is $1.65 at San Mateo. The cost of cement to the Harbor Board in San Francisco is $1.64. If the differential between San Francisco and San Mateo is 14 cents, the cement would cost at San Mateo, even on that basis, $1.78 instead of $1.65. The retail price of cement at the present time is $1.90 net. The last quotation which I got was procured something over 4 or 5 months ago, and I do not know whether the price has been advanced in the past 40 or 50 days.

I am unaware of the nature of the material in the quarry at Calaveras. I have had no experience that would warrant the state-
6116 ment that the drilling and blasting of that rock would not cost to exceed 7 cents a cubic yard, except observation of the methods of working the quarries around the bay, and the statements of some of
6117 the men who are engaged in the crush rock business. I have never examined any of the accounts of such operation.

In arriving at the quantity of lumber that would be necessary for forms I had the height of the dam and the length, and placed inch-and-a-quarter lumber over the whole and allowed the necessary amount of studding, and then made an addition of, I think, 10% for the movable forms in casting the blocks on the inside, and I figured it pretty high. The outside forms I used but once, and the others I did not count on using any specified number of times, but I made an allowance of a certain percentage of the outside forms for the inner ones. Referring to the item $12,000 for the lumber, 480,000 B.M. at $25: The $25 is just for the labor; in addition to that you want to add 480,000 feet at $18.69 divided by 314, the number of full days of actual work. I think that $38.20 would cover the cost of labor for the lumber in laying 500 yards of concrete. I counted on paying carpenters $5 per day, and I think that 7 carpenters could easily do that work. In fact, 3 men could do that without any trouble. I think 6118
that 500 yards of concrete could be laid per day with the use of only 1500 feet of lumber. I have never heard as to the number of carpenters and helpers that were actually employed on the dam when the work was done, and it is possible that it would not make any difference to me anyway whether I had that information or not. I have never built a dam, but I have put in large amounts of concrete, and the principles are the same in any course of construction. If the concrete had set sufficiently, I see no objection to building that dam in such a way as to allow the water to overflow it while it was in course of construction.

While the dam was in course of construction I would provide, to 6119
a certain extent, for taking care of the water other than allowing it to overflow the crest of the dam. I have not done so. That could be done, though, by taking care of all the water that could be taken care of through the outlet tunnel, and taking chances on the rest.

My total estimate of $6.49 for labor and material includes the field overhead. The methods of handling one piece of concrete is com- 6120
parable with another, but the cost varies with the size of the job. The contract price for the retaining walls of the Fort Mason Tunnel was $6.50 per cubic yard; the cost to the contractor was less. We had to let the contract at that price, as under the call for bids the contract was awarded to the lowest bidder on the whole works, and one of the items of the bid was this concrete work, and we had to let that in conjunction with the rest. The cost to the State under that bid if we were to add to that 1¼ barrels of cement at $1.64, would be $8.55 per cubic yard.

The culvert work on that tunnel cost $5 to $6.50 per cubic yard, 6121
exclusive of cement, and taking cement at the same price would make it $2.05, so that the work would cost $7.05 to $8.55 per cubic yard. Notwithstanding those experiences, I think that I could lay concrete for this dam as low as $6.49, and even somewhat lower. I have

figured in this estimate of the Spring Valley dam on the company doing the work and saving the contractor's profit, and I made no allowance for profit in this estimate. The gravel on the Fort Mason job cost $1.45 a yard delivered; the sand cost practically nothing, because they took it from the sand dunes at the site. This work had
6122 an advantage of 19 cents, or something of that sort, per cubic yard, over the Spring Valley work on the two items of sand and gravel.

There would be left $5.75—on the Fort Mason job—to cover the
6123 labor, and all the other materials, but would not cover cement, gravel and sand. Deducting from my Spring Valley estimate of $5.75, the cost per cubic yard for lumber, labor, overhead and plant, would leave a balance of $3.38. The lumber is 6 cents, labor $1.05, overhead $1.26, making a total of $3.38. The miscellaneous item of 8 cents to cover miscellaneous material being deducted would leave $3.30. The contractor on the Fort Mason Tunnel made $2.65 a yard. The difference between $2.65 and $3.30, or 65 cents, is the difference in the jobs. One is a small job and one a large one. The contractor on the
6124 Fort Mason job was Bates, Borland & Ayer. I never saw their books, and we did count in their office expense, but that did not amount to much anyway, because the organization of the office has to be maintained whether they are doing work or not. It has something to do with the overhead, but the expense of carrying on a piece of work, so far as the office organization is concerned, amounts to very little. I do not know positively how this particular firm handled its work, but I judge they handled it in a certain way, basing that impression on knowing what others do, and I do not regard that way of getting
6125 at the profit realized by this particular contract as unscientific or unreliable.

In this Fort Mason estimate I allowed for field superintendents, but I did not compare my items of expense on that with the items of
6126 expense as kept by the contractor. I have made sufficient allowance in the Spring Valley estimate to cover those items by putting down superintendence and engineering at 6% of the total charge of the labor and material, and I believe that is high.

I made no assumption about the condition of the road to the dam at the time this work would have been done. I left that out of the
6127 calculation. As I understood it, that road was to be constructed probably by the County; at any rate, it was to be provided for. The chances are that at that time it would have been a macadam road, and I allowed for the maintenance of it $6,000, which I think is a fair allowance. That would be about $750 a mile for 2 years, which I think is ample for a macadam road used by trucks carrying loads of 7 tons. Referring to the 6 cents in my tabulation allowed for road
6128 construction and maintenance; the construction of roads around the work consumes 2 cents of that, and probably 1 cent more of it would go for the maintenance, so half of it would go for the construction

and maintenance of roads at the dam site. That would leave $3,000 to maintain 4 miles of road for 2 years, over which these heavy trucks would travel, and I consider that that is a fair allowance.

A fair estimate for the weight per cubic foot of concrete in the Crystal Springs Dam would be somewhere between 140 and 150 lbs. The rock weighs about 2700 lbs. per cubic yard; gravel and sand about the same. The total weight of the materials entering into a cubic yard of concrete without the cement would be somewhere about 3600 lbs. per cubic yard. The cement would weigh about 450 lbs., which would make it about 4,050 lbs. total of all the concrete materials per cubic yard; that is on the mix as used on the dam.

RE-DIRECT EXAMINATION BY MR. SEARLS.

Enwood is about 4 or 5 miles east of Sacramento, on the main 6129
line of the Southern Pacific, on the American River.

The function of the flexible pipe in dropping cement from the mixers on to the dam is to hold the material together and cause it to drop at a specified point; by varying the location of the foot of the pipe, the concrete can be dropped where desired.

Questioned by Mr. McCutchen. 6130

Various engineers have various percentages that they assume for contingencies, casualties, etc., and I thought that in a job of this kind 10% would be a pretty fair estimate. That item was intended to include unforeseen contingencies such as a flood, or there might be some difficulty in getting the plant working right in the beginning; there might be accidents to labor. There might be other contingencies, but I did not count on them, except in a general way, to include things that cannot be thought of in advance. I should say that it is prac-
tically impossible for an engineer making a design of a work of this 6131
kind to anticipate all of the contingencies that might arise.

The item of 23 cents for depreciation on machinery is to cover the conveyors, the motors, the mixing plants, the cars, everything but the crushing machinery. The depreciation on the crushing machinery is 11 cents; maintenance and repairs, 10 cents; the equipment charges for installation of a plant, and interest, amount to 11 cents, while the maintenance and repairs on the crushing plant amount to 10 cents. The equipment charge is about 17% on the cost of the plant. I do not think that the value of a burly drill that had been used for 2 years in that work would have depreciated 50%. I have never
handled burly drills, and I cannot say positively whether one would 6132
be worth anything after it had been used for two years. It is hard to say what I assumed it would be worth at the end of 2 years. I have a compressor in that installation, and that would be worth, probably, 50% at the end of 2 years. It would be used in a quarry where there is a great deal of dust, which would, to a certain extent, affect the life of the compressor. At the end of that work the company

would sell that compressor for 50% of its value, I think. The motors
6133 might wear out entirely, but the cost of motors is so small in comparison with other machinery that they could be neglected. The rest of the equipment would consist of one crusher, and the various conveyors, but what they would be worth at the end of 2 years I cannot say, as that is an item I did not go into in detail. That cuts a very important figure in my total estimate, and I am quite sure if the company did that work they could sell that plant, if it were a modern plant, without any trouble, in San Francisco.

Mr. Ellis: I remember of one instance of 2 small compressors we were using. They were each 2-drill machines, and cost us, I think, $950 apiece. We sold the two of them after practically a year's run in the Tabeaud Tunnel for either $1,000 or $1,100. We sold them
6134 to a mining company in the next county.

I do not know what type of burly drill Mr. Newman is using. On quarry drills that I have been in the habit of using the price depends on the cylinder and on the type of the drill. The very common drill for quarrying will run anywhere from 2¾ to 3½ inch cylinder, and we very commonly used to rate them at $1 a pound; in other words, you take two ¾ inch drills they will run varying from $200, and I paid for some as high as $250 apiece, without the tripod, depending somewhat upon the make. The Ingersoll Drills, which have had the best success, will run about $225 without the tripod. I would figure on writing off the entire drill in two years on steady quarry work. One of the big points about a drill is the cost of maintenance; it is the parts that count; after a certain point, when the more expensive parts get pretty well worn out, so that the trouble due to replacing those reaches a certain limit, it is cheaper to discard your drill. I would think it a very remarkable experience to find a drill that had been in use 2 years that had any value, unless you found
6135 somebody who needed it in the immediate vicinity. I do not know of any type of drill that costs $72. Babies ordinarily cost $165. When I spoke of stope machines, I meant a machine that one could hold up and handle, and that is not the sort of a thing you would use in a quarry.

6136 Mr. Newman—Questioned by Mr. McCutchen

I think we figured on something like $20,000 as our total item for equipment for our quarry, and I have allowed $2,200 for depreciation. At 11 cents for crushing a cubic yard you would have to get out about 140,000 cubic yards of rock; that would be practically $15,500 for that item alone. There is another thing to be considered, and that is that the 140,000 yards of rock could be gotten out in one year's working time, instead of two years' working time. By working one shift you could break enough rock to last for the entire two years work. I assumed that the machinery would have practically half its value
6137 at the end of the time, but that does not apply to the motors. The

intention was to cover everything in the nature of auxiliary charges by that additional 10%. I do not catch the distinction between what might be called auxiliaries and contingencies. I cannot imagine any 6138
auxiliaries that would not be covered by my item of contingencies. I have made an extremely liberal allowance for water, but I have made no allowance for camp water, because, as a rule, a profit is returned on that.

RE-DIRECT EXAMINATION BY MR. SEARLS.

The function of a flexible pipe is to keep the mixture falling in a body so as not to spread. My reason for assuming the use of a pipe as against a trough is that there is not so much chance of segregation in the pipe as there is in the trough. I have examined a great many quarries, and am familiar with their method of operation, and to that extent certain data which I have in my exhibit here is based on my personal knowledge of quarrying operations, as far as I could determine from the subsequent inspection of the work. When a man 6139
is interested in a subject, he watches the operations, and mentally determines for himself about what different parts of the work are worth. To that extent I did examine the cost of operation, but as to getting actual figures—I did not do that. My knowledge of the work, and observations of that sort, would enable me, to a certain extent, to judge of the reasonableness and the correctness of the figures I received. I did not consider the method of stripping the forms from the dam upon completion. The $25 is intended to cover both the putting up and the taking down of the forms a thousand.

I have taken a certain price for cement f.o.b. San Mateo, and in 6140
doing so I did not consider the Harbor Commission price at all. I considered the cost of cement to the Southern Pacific Co., and added to that the regular public freight rate from any of the mills in the vicinity of San Mateo, by which road the Southern Pacific would haul cement. In considering the cost to the Southern Pacific Co. I eliminated one price of cement in Utah, as the Southern Pacific Co. could 6141
buy it there considerably less than what they paid for San Francisco cement. Another purchaser would have to pay more because the freight rate would absorb the difference. There were also times when the Southern Pacific paid less than $1.40, and there were sometimes when they paid more, but $1.40 was the average of the prices paid by that company for cement during this period, and I assumed that any other purchaser could have duplicated that price.

Referring to the Fort Mason Tunnel job; I made the cost to the contractor on the concrete up in two ways; one using the mix that they did there, 1-3-6, and the other one on the basis of the mix as 6142
used at Crystal Springs. The total cost of the work, counting cement, was $6.30; if from that we subtract $1.60 for the amount of cement used, it would leave the total cost $4.60. On the Crystal Springs mix

it was $6.98, and we would have had to deduct $2.05, which leaves $4.93. On the Fort Mason job our inspectors kept an actual record of all materials furnished, the price that it cost, the number of men employed on the various operations, and the rate paid. The only possible cost that could exist outside of that would be what little office overhead there was to the contractor. I am not familiar with the kind of offices the majority of cement contractors have in this town, but I am familiar with the offices the general contractors have. I have never been at the office of the contractor who did this work, but he has an office in the Phelan Building, San Francisco, which probably consists of two rooms, with two or three people in them.

Some of the work on this Fort Mason job was tunnel work, which
6143 is usually more difficult than open work like the Crystal Springs. The only reason why the Fort Mason job would cost more, in my opinion, than the Crystal Springs, is on account of its magnitude, and the impossibility of handling it with modern appliances; it was all hand labor. The total yardage of all concrete material was, as I remember it, about 12,000, and a considerable portion of that was tunnel arch, which was more expensive than the rest, and was also paid for at a higher rate; of the mass concrete that would be comparable to a job of this kind, there was something like 8,743 cubic yards. In order to allow for the equipment charges and the indirect expenses, I have made the cost of repairs to the plant, and the maintenance 2½ times what it was on the Fort Mason job. I have counted it at 8 cents a yard on our work, and at 20 cents a yard on the Spring Valley work, not only to be safe, but to be liberal.

Referring to my charge of 6 cents a yard for road construction and maintenance, that was intended to be $9,000; $3,000 for construction, and $6,000 for maintenance, which would modify the figures I gave to that extent.

Questioned by Mr. Greene.

I still think that $1500 would be sufficient for maintenance for
6144 two years, which would be in addition to whatever work the County did. I think in fairness the County ought to do at least 50% of it, but my estimate was not based on that assumption. I think my allowance is sufficient to do it all.

RE-CROSS EXAMINATION BY MR. GREENE.

In considering the Fort Mason costs, the transportation of the
6145 cement is included in our price f. o. b. cars at the work anywhere on the Belt Railroad. It amounts to our paying $1.49 at the mill, and there is a 15 cent freight rate. The price that I named here was predicated entirely upon the prices which the Southern Pacific had paid during years past for cement. According to the testimony here the present price is $1.90 per barrel net, and yet the Harbor Commissioners are getting it at $1.64. We are beating the market

price now 26 cents a barrel. I was trying to get at what, in my 6146
opinion, was the lowest price that cement could be purchased for,
when I took, if not the lowest price, a price that was at least among
the two or three lowest prices that have been named in this discus-
sion, in striking an average as to what it would cost during that
time. It struck me that if the cement companies will reduce the
price to one consumer, there is not only a possibility, but a strong
probability that in a large order of this kind they will reduce it
still more. The fact that the Southern Pacific is engaged in the 6147
business that it is may have some bearing upon the price which it
has to pay for cement, but my price was based on the assumption
that the cement companies, in order to get that amount of business,
would reduce their market rate sufficiently to meet that $1.40 figure.
When the Harbor Commission advertised for bids for cement this 6148
year, they specified a minimum of 20,000 barrels, and they cut that
price 26 cents below the market price. The price of cement for the
Spaulding Dam might afford some indication as to the effect a large
order would have on the market, but the time when the cement was
bought would have some bearing. It it were bought within the last
year or so, it might, but if it were bought before that, I think the
chances are that the market price would have been considerably
reduced.

(Here ensued a discussion among Counsel as to the admissability 6149-6158
of placing in evidence copies of an original report made by Mr.
Herman Schussler to the Board of Directors of the Spring Valley
Water Works in 1887, in which he sets forth an estimated cost of
constructing the Crystal Springs Lower Dam).

6158

Witness: George L. Dillman for Defendants. Dillman

DIRECT EXAMINATION BY MR. SEARLS.

In California my closest connection to flume construction was
a couple of miles of flume for the Rio Bravo Ranch, which I not only
designed, but bought the lumber for, superintended the construc-
tion of, and spent a great deal of time on. That flume was built
in about 1894, and was a bench flume similar to most of the Spring
Valley flumes, with trestles in spots across gulches, which is also a 6159
point of similarity. I had some connection with various flumes in
the mountains every two or three years since that; the most recent
was for the Oakdale Irrigation District, in Stanislaus County. I
built all their flumes. The largest one was 5 x 10 in section, about
a quarter of a mile long, and some smaller flumes 4 x 8 and 3 x 6.
The trestle was Oregon pine, and the box was lined with redwood,
which was a tongue and grooved flooring, inch stuff, sized down to
⅞ths, but the strength of the box was also Oregon pine. These

flumes were constructed in 1912, and the price paid for them was $4 a thousand, which included the lumber, the hauling of about 12 miles on the average, also the erection. The hardware was extra,
6160 and I have estimated it $1 a thousand feet. The freight is estimated at $5 a thousand excess to Oakdale over the freight which would be paid upon lumber for the Spring Valley flume delivered either at San Mateo or at Niles. The wagon haul cost at Oakdale is probably $3 a thousand excess, as compared with the cost of delivering the lumber at the bench of the Spring Valley. Taking the price on the Oakdale flume, and reducing it to the same conditions, so far as location of the construction is concerned, I would expect to find on the Spring Valley work that the cost would be reduced to $34 a thousand.

Hilt Sag Flume; the box is made of the best redwood obtainable, clear, surfaced and edged; it is of either three or four inch stuff, and many of the planks are of extra width, that is, more than 12 inches. I have seen enough of the flumes in California to say that no better material ever went into a flume than went into the Hilt Sag Flume. The flume was 2,018 feet long, and 67 feet high; the underpinning was of Oregon pine. There was contained in that 216,000 feet of redwood, and 453,000 feet of Douglas fir. The con-
6161 tract price on the redwood was $90 a thousand, paid in bonds. The contract price on the Oregon pine was $65 a thousand, paid in bonds. In order to raise money for these constructions, the contractor furnished a buyer for the bonds, and made the discount on the bonds in his price of doing the work. About this time, or a little after that, the South San Joaquin Irrigation District, whose bonds were paid for this work, bought a million feet of lumber, for which they
6163 paid in bonds at 70 cents. At $90 a thousand, with bonds at 2/3 their face, would make the lumber in place worth $60 a thousand; the difference in haul and freight of $7.50 would make a comparable cost of redwood $52.50 in this Hilt Sag contract. A similar analysis of the Oregon pine would make that comparable cost $35.85 a thousand. The weighted average of this price, with hardware at $1 a thousand, would make the cost of the Hilt Sag Flume $42.23, which includes caulking; the caulking was very carefully done.

6166 Referring to page 7 of the inventory, structure 4; I used $3.65 for the trestles. There are two items together there make $3.85 per linear foot for the flume completed. This is one of the large flumes. I have computed the lumber in it at $45 a thousand in place, which includes hardware, caulking and tarring. The lumber will cost on an average of $20 to $22 per thousand; the best redwood in there would cost f. o. b. cars San Mateo $26, not to exceed $28. It will cost to haul not to exceed $4 per thousand. The framing and erection will cost approximately $8 a thousand. The tarring and the caulking will cost $2 per thousand, and the hardware not to exceed

$1 per thousand; the rest of the price will be divided into the contractor's profits, covering contingencies, accidents, and incidents of construction. 6167

Referring to the flume which runs from Crystal Springs Dam to San Andres Dam, comprising the new section, and also a part of the old Locks Creek Line, page 3, item 28, of my inventory. The length is 9,853 feet, at a unit price of $2.85. The lumber is computed at $45, which includes all the lumber, and the unit price also includes hardware, caulking and tarring. That price of lumber is lumber in place in the structure. I used the same prices on the Crystal Springs Pump Flume, leading from Crystal Springs Pump to the junction of this flume, and the Locks Creek Syphon. The difference between my unit here, $2.85, and my unit of $3.85 before, is probably due to the fact that it is a different sized flume. Most
of this lumber would come from the mills cut to order, and be de- 6169
livered as directly as possible, and not pass through the San Francisco yards. The price of lumber is not a fixed thing. My price I believe to be higher than the actual result of purchase would be, but at the same time it is lower than the list prices given out by the
lumber company. I know as much about the lumber in the com- 6170
pleted flume as I do about any of the other elements of cost, and it is in that unit that I think of these things.

In Flume No. 3, Sunol Aqueduct, I have 4,043 feet, inside dimensions 3 ft. 6 in. x 6. The structure lumber I have counted at $45 per thousand, and the extra lumber at $30 per thousand. I allowed 25 cents for earth, 50 cents for loose rock, and $1 for solid rock, which makes a total unit of $5.66. Then the trestles are
added to that, making it $5.85 for the whole flume. I assumed the 6171
base price of lumber there $45, and I think for a good many structures close to town I figure a little less than that. The freight would be a little more to Niles, and the hauling a little less than on the Peninsula. For instance, Trestle No. 4, Structure No. 14, I figured at $40 a thousand. Structure 13 I figured at $45. The excavation here is a short haul, and it can be done by hand for that amount of money. In constructing the benches for this Sunol Aqueduct, I would start it with a plow, and do some scraper work, and finish it up by hand. I would blast the rock where it is necessary. Any sidehill excavation work of this depth, whether it was for a ditch, or a bench for a flume, or a bed for a railroad, would be the same unit cost. For a good many years the unit costs have been
less than these amounts. I don't think there has been any extended 6172
railroad work done as high as 25 cents for earth excavation, with a short haul, for a great many years; 50 cents is fairly high for loose rock; $1 is probably 25% high for excavation of that kind in any quantity, but for small quantities $1 is not out of the way, and these are comparatively small quantities.

The work on the Western Pacific was let for prices less than this, and finished for prices less than this, but the quantities are very much larger. You could equip to do the work for a less unit price there because of the great quantity. There was lots of hand work there. You would hardly use a steam shovel because of the cost of getting it on and off the work. Of course, if your steam shovel was there, you could do it at very small cost. The earth and the loose rock would cost just the same. Loose rock might have to be shot, but I am not sure of it in the Niles Canyon. This price is enough to allow for some shooting.

6173

Dockweiler Witness: J. H. DOCKWEILER for Defendants.

DIRECT EXAMINATION BY MR. SEARLS.

Dockweiler's data on flumes offered and marked in evidence as "Defendant's Exhibit 120".

This table shows the base prices on lumber; the freight, the hauling costs, and the tarring and caulking costs, which I have used in preparing my appraisal of the flumes of the Spring Valley Water Co. Lumber of the same nature, during the same year, varies in price in accordance with its dimensions. For instance, on the second sheet of Exhibit 120, I have set forth under the heading "Redwood and Oregon Pine", various prices which I have used, and these prices are $3 less than the yard price, because it is the cargo price, and I figured on buying my lumber in cargo lots. I obtained
6174 the schedule of lumber at prices at which the lumber was submitted on actual bids to the Board of Public Works of the City of San Francisco. I compiled the list for the fiscal years 1909-10, 1910-11, 1911-12, 1912-13, 1913-14, according to the sizes of the sticks for redwood and for Oregon pine. I took the averages of the prices thus bid, and entered into contracts to supply on with the Board of Works of the City of San Francisco. Under date of May 21, 1914, I received the following letter from the J. W. Schouten Co., lumber dealers, which was in response to a letter from me: "Your "letter of May 15, inquiring the prices of——" "In reply will "state, that during the years 1909-10, 1910-11, 1911-12, and 1912-13,
6175 "we supplied the City of San Francisco on contract according to the "enclosed price list, namely, B, E, F, G and I, as follows." Then it gives the various years, the list, date of the list, and the discounts on the various classes of lumber. I took those discounts and subtracted them from the various prices set forth in the list. There is a 1 x 4 rough common redwood $22; the discounts are $5. I give that here as B. That is $16. Redwood, all grades, $5 off. The price list, rough common pine, October 24th: That is $6.25 off this
6176 B, rough common; he makes it here $5.25.

These lists are entitled "Retail price list B", which is of date October 24, 1908. List E is dated February 7, 1910. List F, June 10, 1910. List G, November 29, 1911, and list I, November 14, 1912. From the prices arrived at by taking the average price for the five years, there was deducted $3, so as to get the price of the lumber on board the cars from the ship's tackle. That $3 deduction was obtained from the office of the Pope & Talbot Lumber Co., and from the Loop Lumber Co., by one of my employees, Mr. Connell. The 6177
memorandum which I used as a basis is dated May 4, 1914, and reads "Regarding cargo prices as compared with prices in piles in the "yard, in cases where cargo can be loaded directly into the car from "the ship's tackle, prices will average $3 per thousand less than "yard pile prices. When lumber is dropped on the dock from the "ship's tackle, and hauled across the yard to the cars, difference "between cargo prices f. o. b. cars, and prices from pile f. o. b. cars, "would be $2.50 per thousand."

I got the following from a conversation with Mr. McDonald, 6178
of the Hoffman Lumber Co., had on May 7, 1914. That conversation related to the price of lumber in carload lots, and I used that conversation as one of the bases for my judgment that a reduction of $3 per thousand could be obtained in carload lots. This is what the memorandum says: "All public utilities in the bay region can 6179
"buy at cargo lots. That includes the Spring Valley Water Co., the "United Railroads, the United States Government, and City of San "Francisco, etc. They must buy at least in 50,000 foot lots. Ex-"ceptions have been made to this. Cost of loading on cars is 35 "cents. That is the price that stevedores will charge you. It will "cost you 10 cents for state tolls." To take care of those charges you ascertain your discount price, which is a yard price, according to this list, and deduct $3. That is automatically taken care of by the companies in getting their material over into the yard. When there is a difference between that and the yard price of $3, you subtract what you have determined your yard price is, and you have your price f. o. b., the lumber on board the cars. I have taken the average prices over these years, with such discount as I would be entitled to as to retail prices, and I have subtracted $3 from that to get my cargo prices.

As to freight charges, my information was from the Southern Pacific Co. $1 is my estimate of the cost of unloading the lumber. The date of my information from the Southern Pacific Co. must 6180
have been in 1914. The $1 for unloading the lumber will also stack it in the yard. That is based on information received from L. D. McDonald, who states in this interview that I had with him on May 7, 1914: "Unloading and stacking in yard $1 per thousand, 9-hour "day in San Francisco, paying your men $4 a day for it." The lumber that you get in cargo lots from the mill would get its

seasoning when it is stacked in the yard. The lumber that I assume for Crystal Springs would be hauled directly to Crystal Springs, and stacked there.

The figures on page 4 of Exhibit 120 includes the cost of loading the lumber on the truck hauling it and unloading it, and are arranged for distances from 1 to 10 miles. After it is delivered on the site, I have made an allowance of $2.75 per foot B. M. per mile for snaking the lumber along the bench. When I come to each of these items in the inventory, I take the distance from the railway station to the point where the flume was to be constructed, multiplied by the appropriate price per thousand board feet here, and then add a differential of $2.75 per mile for the bench haul. I say
6181 my lumber is worth so much delivered at the site, and then this snaking charge is additional.

Excavation prices; they were based on my knowledge of what similar work is done for in this region; especially I investigated the cost of building roads similar to those in Marin County, and what contractors had done that for. I refer to work done around the Lagunitas section in Marin County, back of Fairfax, San An-
6182 selmo, and Ross. The way I got at that was this: I made a cross-section of the road. I made my estimate and classified it into earth, loose rock, and solid rock; a contractor went over and made an estimate of what he would build that road for, and so testified to that cost before the Railroad Commission. This figure was made on my general knowledge of the cost of doing that work at that time. I am further strengthened in that as to the cost of building these roads in the Hetch Hetchy.

EIGHTY-FIFTH HEARING. JANUARY 24, 1916.

Witnesses: J. H. Dockweiler for Defendants.
F. C. Herrmann for Plaintiff.
F. A. Radle for Plaintiff.

6183 (Certain corrections noted in the price of lumber as per letter of J. W. Schouten).

DIRECT EXAMINATION BY MR. SEARLS.

In the letter of J. W. Schouten that I quoted, by comparing the letter with the contract price, I find they were in error but I used the correct prices as given in the contract between the City of San Fran-
6184 cisco to the Board of Supervisors and the J. W. Schouten Co. These figures were taken from the resolutions themselves. I wish to state that the computations I made are correct, but that the letter addressed to me from J. W. Schouten & Co., under date of May 21, 1914, is incorrect in the price which they give for lumber as to the discount which

they allowed the City from List B., dated October 24, 1908, as the discount off List E., dated February 7, 1910. Where they give a discount in their letter to me of $5.25 for Oregon pine, it should be $6.25. Discount of $10 for clear Oregon pine is correct. The discount which they give for redwood all grades, $5, should be $7. Likewise in their List E., February 7, 1910, their discount given is $7.25, and it should be $8.25 for Oregon pine. For clear Oregon pine their discount $16 should be $14. For redwood all grades their given discount is $5, and it should be $7. The discounts which they quoted to me off the Lists H, G and I are correct.

Questioned by Mr. Greene.

My authority is the printed contract of award of contract made to J. W. Schouten & Co.

DIRECT EXAMINATION BY MR. SEARLS. 6185

The contract price for the fiscal year 1909-10 was entered into between the Board of Supervisors and J. W. Schouten & Co., per Resolution No. 4058. The discount which I used in making my computations are $6.25 off List B for common pine, rough; $10 for clear pine; $7 for common and clear redwood. For the fiscal year 1910-11, Resolution No. 6017, discount off List E., rough common pine $8.25; rough clear pine $14; common and clear redwood $7. For the fiscal year 1911-12, Resolution No. 8003, discount off List F., rough common pine $5.50; clear pine $13. Common and clear redwood $7. For the fiscal year 1912-13, discount off List G., rough common pine $5.50; clear pine $14; redwood $6.50. That is per Resolution 9525.

The Board of Public Works entry for this discount is only $6. I use that instead of using $6.50 discount. In other words, the discount is 50 cents too small, owing to using the memorandum of the bookkeepers of the Board of Public Works for that; the actual discount was $6.50 set forth in that resolution. For the fiscal year 1913-14, discount off List I, rough common pine $4.25; clear pine $11; redwood $4.50. That is as per Resolution 10,234. Using the lists indicated, and discounts given, I prepared the tabulation for the five years for which these prices were given. I then took the average of 6186
those five years, and from that average thus obtained, deducted $3 from the yard price as f. o. b. cars ship's tackle. I don't recollect making any inquiries as to whether the discounts the Board of Works got were more than the ordinary.

My base price per ton mile for hauling varied for each mile. The exhibit which I filed gives the price for hauls varying from 1 to 10 miles. I took the average. I took what in my opinion would be an average condition. On some of the extraordinary steep hills the price would be say close, but on a good average road, the price in my opinion is very little.

Questioned by Master.

I got the figure of $3.51 from 10 mile one-way haul because the truck would cost me, with profit and allowance for road maintenance, etc., $31.78 per day.

DIRECT EXAMINATION BY MR. SEARLS.

I assumed there would be three round trips a day as an average; 3.18 round trips per day. On a 10-mile haul that would be 60 miles a day.

6187 Questioned by Mr. Greene.

I used a 9-hour day. Lumber; assuming 3½ pounds per foot board measure, an average weight of five tons would take 2850 feet board measure. A laborer will load and unload about 10,000 feet of lumber in a 9-hour day. The following gang will load and unload a 5-ton truck in 20 minutes, a quarter of a foreman, 7 laborers, allowing 25% for lost time, that will give 23.12 for 9 hours' actual loading and unloading. Dividing that by 540 minutes in the day, it gives you 4.3 cents per minute of actual loading time. The cost of loading and unloading in 20 minutes is 86 cents. This information was taken from lumber people as to what can be done. I sent my men around to the various lumber companies to get what average conditions were. 6188

DIRECT EXAMINATION BY MR. SEARLS.

My recollection is I sent Mr. Connell to get those figures, and I am satisfied that I sent another man, because I had independent inquiries made on one man's record checking the other.

6190 Stone Dam Aqueduct Flume comprises 240,524 feet of rough
6191 redwood. That is made of four classes of lumber. Of the 1½ x 14 there are 14,531 feet; the labor cost on that per thousand is $30. The lumber is $41.50 per thousand. Of the 1¼ x 12 there are 81,740 feet. The labor on that is $13 a thousand. The cost of the lumber is $17.50 per thousand; the 2 x 12 there are 14,772 feet; the cost of the labor on that is $12 per thousand; the lumber is $16.10 per thousand. My labor costs of $12 and $13 are based on working carpenters 8 hours a day at $5. I don't exactly recall what I did allow the foreman, but I have $2.50 a day for helpers, and $5 for carpenters, 8 hours per day. I could not figure how many thousand feet a carpenter could build. Each grade of lumber gives a different output; where it is, and how they get at it, etc. That is the best I could get. It is just a question of judgment. I could not arrive at it in any other way. As I recollect it, I have no statistics and no records other than that of costing so much a thousand to frame up. The amount that would have been framed in a day varies, there is a limit. With very thin material you frame comparatively small quantities. I recollect once trying that on some small flumes I built in Los Angeles, but I gave it

up. I couldn't get at it. I worked out for each of these flumes and 6192
used the same wage scale in each case. I used the same for Alameda
County that I did in San Mateo. The foreman got $6 a day. I had
common laborers at $2.50 a day, and they were helping carpenters,
and would not work over 8 hours. Common labor on the outside
work is taken at 9 hours, on excavating and work of that sort. 6193

Of the 4 x 6 there were 129,481 feet. Cost of labor was $12. The
net cost of lumber was $15.70. This makes the total of 240,524 feet
of rough redwood listed. The average cost of that lumber is $17.89.
The average cost of labor is $13.50 per thousand; freight to Millbrae
$2.33; hauling $2.05; nails $1.10; hauling along the bench $3; add-
ing $3.38 brings it to $43.45, which I have rounded off to $43.50. The
average haul along the main flume is 5,690 feet. That is explanatory
of what I call hauling along the bench, $3. My excavation cost was 6194
not taken on the same basis as I used for trench excavation. That
analysis of cost of handling the earth work was based upon my
general knowledge of what work is done for in the bay region, and
what it has been done for. For instance, the contract on the Western Pacific between E. B. & A. L. Stone and the company for all the
work performed, up to and including the 31st day of August, 1907,
from Oakland to Alameda; loose rock on that contract was 45 cents
a cubic yard; common excavation was 18 cents a cubic yard. I don't
think there was any steam shovel work on that job at all.

Questioned by Mr. Greene.

I know the road bed, it is up to the Niles Canyon. It is from Oakland to Alameda Creek. It is not along Alameda Creek. I have been along there. (Stricken out).

DIRECT EXAMINATION BY MR. SEARLS.

In the Crystal Springs Pump Flume there are 307,888 feet of
lumber. I have used the same wage basis there. Of the 1¼ x 6 there 6195
are 4,000 feet. The cost for labor was $15. 1¼ x 12, 30,000 feet;
labor $12. 4 x 6, 173,000 feet; labor $12. The average cost of the 6196
lumber is $16.44 per thousand. The labor is $12.25; freight to Millbrae $2.33; hauling to the job $2.34; nails 95 cents. I add to that $3.06 which makes $37.37, which I round off to $37.50 per thousand. For excavation I use the same base prices, 30, 50 and 75 cents.

Defendant's "Exhibit 121" admitted.

The Sunol Aqueduct contains 147,710 feet. There are 8,000 feet of lumber of ¾ x 4 inch material. The cost of labor on that is $25 a thousand. Of the 1¼ x 12 inch there are 7,000 feet, which cost $13 per thousand for labor. There are 42,000 feet of 2 x 12 material which cost $11 per thousand. There are 90,000 feet of 6 x 6 material which cost $11 per thousand for labor. I am using the nearest thousand in quantities. The average cost of this lumber is $17.69 per thousand. The labor is $12. The freight to Sunol is $3 a thousand.

Dockweiler

The hauling is 88 cents per thousand; nails 95 cents; and I add $3 which rounds off to $37.50 per thousand. I have the same price on excavation. As to that excavation, it is all benching. You throw it over. It is not like railroad work where you use the material and then have to haul it in some cases to make a fill; it is narrow. I am satis-
6197 fied that all my prices are fair. I deduce that, in a measure, by the contract prices which have been let by the City of San Francisco for work in the Hetch-Hetchy, and by contract prices let by the State Highway Commission in five or six counties. As to the Hetch-Hetchy work, I was informed by the City Engineer. I know of some con-
6198 tracts for the Highway Commission. I know the general character of the work. I have not been on every job. I have been over some of the work where it was being done. I was not on every piece of work. I have not seen the work being done under the contracts, but I have a record of all the contracts let in these five counties. There is a contract for doing work in Marin County. I saw that, and was along that work while it was being done. Not every day, though. They used the steam shovel on one cut. The steam shovel work was a very
6199 small part of it.

Herrmann Witness: F. C. Herrmann for Plaintiff.

CROSS EXAMINATION BY MR. SEARLS.

The flumes which I spoke of in the Modesto Irrigation District were not 20 miles of flume. They were scattered along a distance of 20 miles. The length of the flume I think was about a mile, or a mile and a half total. At the time they were built the haul was from Waterford. The average haul, I should say, was in the neighborhood of 10 miles. I don't know the freight from San Francisco to Waterford at that time, but I can look that up. The rate is something less
6200 than $8 there today, according to my recollection.

I would not say that the average haul to the Spring Valley flumes was 10 miles, and the freight rate would not be anything like $8 to Millbrae or Niles. I use the Modesto costs simply as a check on my appraisal of the Spring Valley flumes, and did not make any deductions for the difference in haul or in freight. I would not expect that they would check exactly anyway. Their checking approximately would depend upon circumstances. The different flumes in the Spring Valley system do carry different costs, and while the miles of haul might be less in different instances to the Spring Valley flumes, the character of the roads and other conditions entering would perhaps offset the difference in distance so that the haul might be reasonably the same. There is a road all the way along the canal now, and I presume there was when they were building the flumes, because they were
6201 working at different places along the canal, and had roads to get to

the canal and to the work. The country where the canal runs, and where the flumes are is a very gently rolling country, and not at all comparable to the irregular topography you encounter in the Peninsula System of the Spring Valley Water Co.; you have not the narrow roads, the hillsides, the steep grades, the abrupt changes in gravity, and the dangerous travel in the roads along the Modesto Canal that you have in the roads of the Peninsula System of the Spring Valley Water Co. The prices of the Modesto flumes do not include excavation. They are the prices for putting the lumber in place. The work was taken on contract with the District. One of the Modesto contracts was paid through bonds, and the one I am talking of now, and that I understand you are talking about, was a cash proposition. In the contract of 1903 there is an excavation item, a unit bid for excavation. I am quite sure that the prices I gave simply include the handling of the lumber, regardless of excavation. However, I will verify that. The flume from La Grange to Mill Gulch was built under 6202
bond issue where I gave a depreciated value of the bonds. The New River Flume in Imperial Valley, 1400 feet long, was partly built on a high trestle. The labor cost was $25.50, and it included the work of erection, and the transportation from the place of deposit by the railroad, which was less than half a mile, and which was handled through floating the lumber down through the main canal to the place of use. The flume is in Mexico. We paid duty on the lumber, which is not included in the $25, the labor cost. We used carpenters and carpenters' helpers. We always had quite a crew of carpenters. We got 6203
them from Los Angeles and other places. The cost does not include the cost of bringing the labor there. We had no trouble with floods. It was built after the Colorado River had been closed. New River carries very little water, except in instances like when the Colorado River broke, and then it was a raging torrent. The figure for framing is not considerably higher than the one I used. Framing is not the entire labor cost. That is not comparable with the $12 I have used. The handling from the place of deposit to the flume, the labor crew, that is on the flume with the carpenters, is not in my $12. The $12 is just carpenter charge. I didn't encounter any unusual difficulties in that. It made my labor cost $25.51 per thousand. The San Jose Water Co.'s flume was in the neighborhood of that price, I think. There was not very much wrecking in that job, but it does include what 6204
little there was. Most of it was taken out by dumping down over the bank so that it was not a very large charge. The labor charge on the San Jose flume was $27 per thousand. The lumber delivered as nearly as they could get it with teams was $45 per thousand. The $27 does not include excavation. The bench was excavated at that time. There may have been some little trimming, but very little. I mean re-grading. I do not know what the carpenter charges on either of these flumes, exclusive of labor, was. In the San Jose flume the lumber

was delivered as near the bench as they could get, at $45 a thousand. In the $27 is included the distribution along the bench, which perhaps averaged half a mile from the nearest points.

Some of the Los Gatos Canyon between Lexington and Los Gatos is rough sidehill. Some of it right in Los Gatos is very moderate sidehill. Some of it, through Lexington, is nearly flat. Through Alma
6205 it is very moderately rolling. That is the canyon where the railroad goes through to Santa Cruz. Part of it is steep and rocky. On the other stretches it is not. It is not nearly perpendicular, but it is very steep.

Questioned by Master.

The work was done within the last five years. I have not the date exactly, but I will get it. It is a recent flume.

CROSS EXAMINATION BY MR. SEARLS.

The bench was there, and the men had that bench to work on. There were no swings necessary. We had to build some trestles. They are included. Trestles, however, are not any more numerous than they are in the Spring Valley flumes; I should say about the same thing. The steepness in the steepest places is probably not very much more than that part of the Stone Dam Aqueduct Flume between the outlet of Tunnel No. 1 and San Mateo Creek.

Questioned by Mr. McCutchen.

The lumber was bought somewhere between Wright's and Felton.

6206 CROSS EXAMINATION BY MR. SEARLS.

It was bought from a local mill, and they sawed it right on the ground. I don't think the prices were any better than the ordinary retail price of lumber, because there was some extra width lumber sizes. That is all included in the $45. The extra width in some instances increases the cost, and in some it does not. The lumber that entered this was all first-class lumber similar to that that is in the Spring Valley flumes. My information as to the price of lumber was given to me by the purchasing agent of the Spring Valley Water Co., Mr. Head. I don't know whether they were retail or wholesale prices. I explained to him why we wanted it, and that there would be the purchase of a large amount of lumber. As I recollect it, it was somewhat less than what we were paying for lumber when we bought it
6207 at retail.

Questioned by Master.

My idea of framing is the carpenter force, the $12, and does not include the labor, except a very small percentage that goes with the
6208 cost of the work. The labor items not included in my $12 would be the work of packing lumber and snaking it along the grade; the labor that is handled in that way outside of those who act right with the carpenter in placing the material.

CROSS EXAMINATION BY MR. SEARLS.

The Sunol Aqueduct, speaking generally, runs along the road. Nevertheless you have to handle the material between where you can get it with teams and where it is put in place. The road does not travel to within a few feet of the aqueduct. In many places there is a railroad between the road and the aqueduct. In many places it is on the opposite side of the stream. The $6.50 includes first, sorting, piling, sticking, watching, building fire-guards at the lumber-yards at Farwell and Brightside. Teaming from these yards to the piles along the flume, loading and unloading, and then carrying from the piles to the flume grade, and a labor charge with a carpenter crew on the grade, which aggregates $6.50. The first item of sorting, piling, sticking, watching and building fire-guards at the lumber yards, for clear surface redwood, I use $1. Loading and unloading into teams 50 cents. Teaming with an average haul of one mile, 75 cents. Carrying from the pile to the flume grade $1.25. Labor with the carpenters crew along grade $3; making a total of $6.50. That is so far as the surface redwood is concerned. I have done the same thing with the rough redwood, and the rough Oregon pine. I finally get a total for 6209
rough redwood of $6 per thousand, and for rough Oregon pine of $5.50 per thousand. I don't think you could deliver the lumber directly from the train along the flume, because in the first place you want to season your lumber, and you have to pile it and stick it in order to get seasoned lumber and a good job. I considered it needed seasoning on the ground in addition to what seasoning it had in the yard.

The purchasing agent didn't state whether it was seasoned or unseasoned lumber. As a matter of fact, any lumber that is kept in these yards here, with the fog and rainy weather that we have, would need seasoning anyway before being put into a flume of that character. As a matter of fact, the only place where you can get cars set 6210
out would be Farwell and Brightside. You couldn't stop cars on the main line and dump your lumber out from them. You would have to use those two places to load your trucks from your cars, and then you would have a pretty hard job getting your trucks from those cars to the flume grades and along the flume grades. I think that by the time you got through you would find it would cost more than by the way I have analyzed. The reason I chose Farwell and Brightside was to reduce the haul as low as possible. If it were Sunol and Niles, the haul would be more than from Brightside and Farwell. I don't think it would obviate handling. You would have to handle it and rehandle it just as many times. I doubt very much whether you could take the lumber directly from the railroad yards or a yard of our own at the nearest station, store it and carry it by truck to the point where you wanted it, and snake it up to the bench. This flume going down to Niles Canyon is not a continuous flume; there is a stretch of flume

6211 and a stretch of tunnel. You have two railroads and a county road going through there, and very often there is a railroad track between the flume and the county road. The flume is some distance in elevation above the floor of the stream bed. The county road many times is on the opposite side of the creek from the flume. It would necessitate the building of a great many approaches in the sidehill work for your trucks to get up in order to get from the county road to your flume bed; then if you use the flume bed for your trucks you would cut it up so badly that you would have to re-grade the whole thing in order to lay your flume.

6212 Questioned by Master.

The operation would be just the same if the lumber were taken from Niles and Sunol or from Brightside and Farwell. I didn't truck any on the flume grade, because I didn't think it practical to do so. I selected Farwell and Brightside because there would be less hauling than from either Niles or Sunol. The method I used to get from there to the flume would be the cheapest way you could handle it.

CROSS EXAMINATION BY MR. SEARLS.

My method was to team from these yards at Brightside and Farwell, an average haul of about a mile. To pile along the flume line and then carry from those piles to the flume grade. Those piles would be below the flume grade, and you would have to carry it up there. The labor crew that worked with the carpenters would distribute it between those piles for the use of the carpenters. Those are the only operations that I had outside of the sorting and piling at those two places, for which I have charged $1. You certainly would have to inspect and sort that lumber before you could put it in the flume, and
6213 you would want to season it also. I think it is necessary to sort and pile and season the lumber before you put it into the flume. I assume it is all seasoned before it is taken from Farwell or Brightside. In the first place, you would not want to use trucks from the yards to the points near the flume, because you have to cross the stream bed with gravel and sand in it, and it would be economical to use teams. Those teams would have to deposit that lumber at the foot of the slope below the flume grade, and put it in piles so that it could be used. I don't pile it again and sort it. I team to those places, and then you have
6214 to carry from there up to the grade. You have to handle this surfaced lumber in a much more careful way than on a drag, or else the flume would be in a very poor shape when you had it completed. All of the box is surfaced lumber. I think about half, as I recall the inventory, is surfaced lumber on three sides. I have gone through the same performance with all these flumes. I didn't put them in on my direct examination because I didn't want to litter the record up with all that sort of detail, but I have it all here and would be very glad to give it to you if you want it.

The sorting, piling, sticking, watching, etc., is $1 for surfaced
lumber; 75 cents for rough redwood; and 50 cents for pine, my idea
being, of course, that much more care would be taken in the case of
the surfaced redwood than with either the rough redwood or rough
Oregon pine. I figured that under those conditions a laborer would 6215
handle of the surfaced material about 2500 board feet a day. That is
based upon my observation of handling lumber in that way in the Imperial
Valley, where we always kept a very large lumber yard of our
own for all this work. I had charge of that work, and from my knowledge
of what those men did, that is my idea of what that would cost.
Some of the labor there was Mexican. I have never made any inquiries
in San Francisco as to what a man would be expected to pile.
This is not from my Imperial Valley experience alone in handling
lumber. I have had experience in a great many other places, and that
is my idea of what it will cost. I have handled lumber with the Spring
Valley Water Co., and with the San Jose Water Co., and other work
that I have been on. Am handling lumber now with the Modesto Irrigation
District. I have not the cost analysis now, but costs were kept
at that time, and my recollection is that that is what they did. I observed
them a great many times, and kept track of those costs. My 6216
figures are not based on information given me by Mr. Lawrence. I
have talked with Mr. Lawrence about it. My recollection is he thinks
it cost more than that. Some of the estimates I have made are based
on records that were gotten out by Mr. Lawrence. Taking Mr. Lawrence's
data, which is simply the records of the company, I have
worked out the amount of board feet that have been laid per carpenter
per day on each of the flumes that have been built, of which we
have a record, and have used that, together with my own judgment
and estimate of the crew to get the framing cost. I have all that detail
here, and can give you the result, so that you will know just what
I have used of Mr. Lawrence's. I have used his figures on the rate
of output per man, and that, of course, is a Spring Valley record
compiled by him.

The hardware is also taken from Mr. Lawrence, 65 cents. I 6217
testified that the hauling, re-piling, sorting etc., is done in accordance
with Spring Valley practice. It is not a universal practice.
Sometimes it is used, and sometimes it is not. That is usually reflected,
however, in the character of the work in the finished
product.

The Stone Dam Aqueduct is one of the longest and largest of the
Spring Valley flumes. The first section of that is 4800 feet long,
according to my recollection. I figured on beginning that at the
Stone Dam, and working downstream. I don't think it would be
possible to float lumber down. I think it would give some trouble 6218
and grief more than any gain you would make. I would not say
it was a constant practice. In some places it has been done. It

depends entirely upon the circumstances. You have a good-sized flume and plenty of water, and you have a very crooked flume, and you would have an awful hard time getting your boards down around those crooks unless you sawed them up before you started them, and you can't do that because you don't know what lengths you want to saw them until you get them right on the grade. That is the difficulty of using that practice there. I assumed taking the lumber along on top on hand trucks, and I get a figure of $10.50 for handling clear redwood. That, however, is from the picnic grounds, and not from the Stone Dam. The analysis of that $10.50 would be the haul to what we call the picnic grounds above the Stone Dam. Beyond that point the road is not large enough for hauling with motor trucks. The road could not be made large enough at a very small expense. If you make it large enough, you
6219 would also have to provide at the Stone Dam room to turn around and room to pile your lumber, and by the time you got through I think the charge would be a very considerable amount. I believe it would be cheaper to stack the lumber at the picnic grounds, and then haul with small team trucks from there to the Stone Dam, and then hand-truck along the flume; believing that to be the cheapest, that is the way I have made my estimate. So I have, as in the other case, sorting, piling, sticking and watching, and building fireguards at the picnic grounds $1 for surfaced timber. Teaming from the picnic grounds to the Stone Dam in small lumber trucks, 1 mile, loading and unloading $2.50; $1 for the loading and unloading, and $1.50 for the hauling. The hand-trucking from the Stone Dam to the piles along the flume, an average haul of half a mile, and the cost of the runway upon which to run your trucks, would amount to $4 a thousand. The labor crew with the carpenters would be $3 per thousand. That gives the sum of $10.50 for the surfaced lumber, $9.75 for the rough redwood, and $9 for the rough Oregon pine. In hand-trucking over the top of the flume you have to provide for a runway, because in carrying that much lumber over it you would wear it out, so therefore, that must be charged to the job. You have that runway on top of the flume anyway, but you don't want to wear it out. I figured on putting two boards extra; two 2 x 12 which would be used up in carrying that lumber. I charged that in, and it amounts to $2 per thousand of the boards in the flume. In-
6220 cluding the stacking at the picnic grounds, I have a total charge of $10.50. The Crystal Springs Flume parallels a road, I would say, from a few hundred feet to a thousand feet distant. It is possible to send a motor truck along the top of the ridge there. In that case you would haul the lumber to Sawyers Camp. That is the central place, and is where your yard would be. I would haul directly from the train out to these lumber-yards on the ground. In this case we use the Sawyer Camp. We have the sorting, piling,

sticking, watching and fire-guards $1; hauling in wagons from there up to the spurs on the ridge, an average haul of 2 miles, which I think would cost 50 cents per ton mile, and plus the loading and unloading would be $1. Distributing from these spurs to the small piles along the grade would be $1 a thousand. Then the labor crew 6221
with the carpenters would be $3, and you would have a total of $7.50; $6.75 for rough redwood, and $6 for rough Oregon pine. $3.50 is spent between Sawyers Camp, and these spurs where the $3 expense begins. $3.50 per thousand for hauling from there to those spurs, of which $1 is for loading and unloading, and another $1 for taking it from the nearest point you can get it, and carrying 6222
it down to the flume line on the spurs by hand labor. You understand that the wagons and trucks could not get down to the point where the flume crosses these spurs. My idea of the handling is $1 a thousand. $3.50 is not for hauling two miles; there is $2.50 for the loading and hauling, $1 for sorting, and $1 for taking it from the piles on the spur to the flume on the spurs. The lumber would not be hauled directly from the train to these knolls, because of the same objection as there is in the Niles case. You want to give this lumber a chance to season, and you want to inspect it and cull it and take care of it. You would need a central yard there from which to work. There is room on top of the ridge, but handling that way would probably cost just as much as handling it another way. Sawyers Camp is a central place for a number of these flumes. You 6223
would be able to handle and get out your material and everything else expeditiously there, whereas, if you had it up on top of the ridge you would probably have a good deal of difficulty; besides that you would be hauling it higher than was absolutely necessary, and when you got through you would have to haul it down again. There are some things in the Stone Dam Aqueduct that do not occur in this flume, and there are some things that occur in here that do not occur in the Stone Dam, and if you deduct some, you will have to add others.

Table of cost of rip-rap annexed to "Plaintiff's Exhibit 105" 6224
entitled "Earth Dams and Flumes".

Questioned by Mr. Greene.

The prices on rip-rap, Modesto work, were obtained from the contracts and bidding sheets of the Modesto Irrigation District, in work now being done under my supervision. I am familiar with every phase of the work in the contracts.

CROSS EXAMINATION BY MR. SEARLS.

The rip-rap is about 12 inches thick. Some of it is very hard hardpan, which is almost the same as stone. The other is of a softer hardpan.

Questioned by Master.

There is a range here between 5 cents and 16 7-10 cents. As I
6225 explained before with regard to the 5 cents, that is the rip-rapping below the concrete structure. The material used for that rip-rap is largely excavated from the place where the structures go in. The contractor got paid for excavating hardpan which was used for rip-rap, so that the 5 cents here represents really the cost of placing that, and not excavating it. The hardpan is as hard as rock in places. Locally they call it rock.

CROSS EXAMINATION BY MR. SEARLS.

It is not soluble in water. A good many of the banks of the canal have been rip-rapped with hardpan there for 5 or 6 years, and they are in good shape. At the Salter Fill, at Reardon, and at Indian Hill it is very hard hardpan, practically rock. It is not difficult to get satisfactory rip-rap in the Modesto District. This hardpan is satisfactory. Outside of the hardpan it is. That is why they use the hardpan. At these different sites it is plentiful. You have to go but a short distance to get it; a matter of a few hundred feet. The hardpan was used on the Salter Fill and the Reardon Dam. A contractor would get what it would cost for him to get out this hardpan and put it in the form of rip-rap on the embankment. All the contractors bid on the same thing, and you have a number of contractors bidding on this one job. They all have the
6226 same chance. The specifications provided that it may be hardpan, and as a matter of fact, that is what it is. The contractor's price would not be governed by the cost of getting regular rip-rap. As a matter of fact, this is regular rip-rap. This hardpan that I spoke of is very hard and a very good substitution for rock. It practically is rock. The contractors all understood that that was what was to be used for rip-rap, so that there was no occasion at all for them to inquire into the cost of bringing rip-rap in the way of rock from a distant source.

Statement by Mr. Greene: The measurement from San Mateo Station to the base of the dam is 22,450 feet, which is the equivalent of $4\frac{1}{4}$ miles. The distance from the station to the top of the dam is 23,800 feet, which is equal to a little over $4\frac{1}{2}$ miles. That was obtained by surveying last Saturday.

6227 CROSS EXAMINATION BY MR. SEARLS.

My price on hauling was in a measure based on the contract prices at Calaveras. I figured 30 cents per ton-mile, plus 25 cents for the contractor's handling at one end. We handled it at the other. On the Peninsula System for lumber I assumed 40 cents a ton mile, and on the Sunol 30 cents a ton mile. I assumed also that the cost of unloading, piling and sticking would be $1. My increase

per ton mile over the Calaveras price was for the reason that I took the number of trips. I went through the operation of finding the number of trips a truck would make from Millbrae to San Andres, and resolved that into the price per ton mile. It was 40 cents. Then by reason of the fact that the haul to other places in the Peninsula System was over difficult roads, narrow, steep and tortuous, I believed that 40 cents per ton mile would apply equally well to other places as well as to San Andres, the idea being that the road difficulties would offset the delays that would ensue because of the fact that the haul from Millbrae to San Andres was comparatively short. That is why it was 40 cents a ton mile. The haul, of course, is less than from Milpitas to Calaveras. The delays occasioned will increase the price. All else being equal, the longer the haul the less will be the cost. I did not say that the grades from San Andres to the summit of Sawyer Ridge are any steeper than the
last part of the grade from Milpitas to the top of the Calaveras 6228
Divide. I think there are stretches in the road that are about the same. The road from Milpitas to Calaveras is very wide comparatively. The turns are not abrupt, and speed can be used both going and coming. There is little danger of meeting other trucks coming in the opposite direction. The road from San Andres to the top of Sawyer Ridge is very much more tortuous and narrow. Great care must be taken to prevent accidents because of meeting in unfavorable places; the grade is narrow, so on the whole it is a much more difficult haul from San Andres to Sawyer Ridge than it would be from Milpitas to the top of the Calaveras Ridge. If you were building all of these flumes at the same time, you would have trucks running in both directions on all roads, and you would have to have some sort of a schedule, because of the fact that you have accidents with motor trucks, engine troubles, it takes much longer at one time than another to unload and to water, and things of that sort. There would always be delays in these meetings. There would be loss of time, undoubtedly. You could not lay out any program or schedule and adhere to it unless it was a very slow schedule, so that you left ample time for trucks to arrive at meeting places. The meeting places on those steep and crooked grades are few and
far between. You don't have punctures with motor trucks. They 6229
would all increase the cost of hauling. I believe it is very fair to say that the cost per ton mile would be the same for the rest of the places as it is from San Andres to Millbrae. I didn't figure on cement hauling. The cost of hauling lumber would be greater than hauling cement. For instance, the Calaveras contract in 1913, that I quoted, we paid 30 cents a ton mile for hauling lumber, and we paid the man for piling it. He hauled cement for 28 cents a ton mile, and loaded it at his own cost. It is very much easier to handle cement in trucks than it is to handle lumber. It is more difficult

to put a ton of lumber on a truck than it is to put on a ton of
6230 cement. At Calaveras the same man had both contracts. There were no formal bids. We went around and saw different truck operators. I have some other figures on hauling to Calaveras besides that. In November, 1915, just past, the hauling of the lumber for the wasteway structure, and other purposes at Calaveras, from Milpitas, was 34.6 cents a ton mile, and included the cost of loading. The hauling prior to that in 1915 by teams cost 36.3 cents per ton mile, on the basis of a 10-hour day, 4-horse team up being paid $7, 5-horse team up being paid $8, and a 6-horse team up being paid $9 per day. "Up" means including the wagon, the driver ready to go, harness and everything. Carpenters at Calaveras worked 10 hours in 1913, all the time I was over there. I figure 8 hours on flume construction both in Alameda and San Mateo, the reason being that the carpenters we had in Calaveras were very rough carpenters, not the type that would be necessary for flume construction. I figure on using the best in flume construction. I give them helpers
6231 and laborers both. I believe it would be impossible to get carpenters to work 10 hours at Pilarcitos or any other place on the Peninsula. The custom has been established there a long time of working 8 hours. You are nearer the center of activity. If you have good, first-class carpenters at Calaveras, they would not work over 8 hours a day. That is my belief. Most of them there are rough carpenters. There has not been any work there that has needed as close work as is necessary on flumes of the character we are speaking of. Flume erection is not simple carpentering, especially in these flumes that are so crooked, where you have to mitre all your boards, and chamfer all your posts at turns, and work out your intersecting sills. You need a first-class carpenter. You have to get your gains, and your caps and sills at the proper place so you
6232 can get a good tight flume. Gains are in the flume. A gain is a notch in the sill in which the posts rest. The tightness of the flume depends largely upon the skill with which that is placed.

RE-DIRECT EXAMINATION BY MR. GREENE.

The average haul for the flumes on the Peninsula System is 8 miles. If you include the Sunol flumes with the Peninsula flumes, the average haul is 7 miles. That is one way. Extra width lumber increases the cost of flume work to some extent. The San Jose Flume, I would assume, has about half of the lumber extra width. It would make a difference in cost of perhaps $2 a thousand.

Lumber could be handled to the extent of about 500 board feet per carpenter day of the carpenters used on the job. I have arrived at that by analyzing the physical data given in Mr. Lawrence's
6233 exhibit on flumes. I have taken each flume, for instance F-5, which is a 3 x 5 flume. The board feet per lineal foot of flume averaged

47.6; the length of the flume is 2125 feet; the carpenter days given by Mr. Lawrence amount to 226¾. It was built in 1902. From that I figure that the length of flume built per carpenter day on that job was 9.42, which multiplied by 47.6 board feet per lineal foot gives 448 board feet per carpenter day of 10 hours. Reducing that to an 8-hour basis, it would be 359 board feet per carpenter day.

On F-7, the Pilarcitos Flume extension, which is 21½ x 3 ft. 6 in., and has 35½ board feet per lineal foot; the length is 2759 feet; carpenter days given by Mr. Lawrence 248¾. It was built in 1904. The progress was 11.1 lineal feet of flume per carpenter day, which multiplied by the board feet per lineal foot gives 394 board feet per carpenter day of 8 hours. That was an 8-hour job.

Similarly on F-8, the Stone Dam feeder, by going through the same operation we get 504 board feet for a carpenter day of 8 hours; and similarly on the Stone Dam Aqueduct, first division, which was a 4 x5 flume, we get 575 board feet per carpenter day of 10 hours, or 460 board feet per carpenter day of 8 hours. The Stone Dam Aqueduct divisions, 2, 3 and 4, which are of various sizes, I get 644 board feet per carpenter day of 10 hours, or 515 board feet per carpenter day of 8 hours.

F-12, Crystal Springs Pump Flume; by going through the same operation I get 534 board feet per carpenter day of 8 hours. On Niles Aqueduct, F-17, I get 444 board feet per carpenter day of 8
hours. On Sunol Aqueduct, F-19, I get 750 board feet per carpenter 6234
day of 10 hours, 600 board feet per carpenter day of 8 hours. This includes flume and trestle. I make my deduction from an 8 to a 10-hour day on a straight percentage basis. I group those into jobs of 10-hour days and 8-hour days. The average of the 10-hour days is 650 board feet per carpenter day, which reduced to an 8-hour day is 520 board feet per carpenter day. The 8-hour jobs put together give an average of 482 board feet per carpenter day. The average of all the jobs on an 8-hour basis is 510 board feet per carpenter day; so that in my computations I have rounded that out and used 500 board feet per carpenter day.

Questioned by Mr. Searls.

I did not give it on a 10-hour basis, except those that were 10-hour jobs. The ratio indicates that the rate of progress per hour is practically the same for an 8-hour day as for a 10-hour day, so that the direct resolution by percentages seems very fair. It seems the right thing to do. You can tell that from these figures.

Table submitted and annexed to Herrmann's Exhibit 108 on flumes.

The average of all these flumes taken all the way through show 6235
the board feet per lineal foot to be practically that of a 3 x 5 flume; so from that a 3 x 5 flume would be the reasonable size flume on the Spring Valley system. Then I assumed a crew that I thought from

my experience would be required to do this work. That crew, for what I call framing, which is really the carpenter work, amounts to 27 carpenters at $5; 4 carpenters' helpers at $3.50; two laborers working on the blocks, $2.50; one watchman; one foreman at $6; and a water-boy at $2, making a total crew of $165. There are 27 carpenters in that gang. Based on the record given, or of 500 board feet per carpenter day, they would place in the flume 13,500 board feet a day, and it would cost $165 for that crew, which would make a cost per thousand for framing of $12.20, which I have rounded off to $12. Working with that crew there would be 14 laborers and 1 foreman at an aggregate cost of $41. With the same number of board feet being placed, that would mean a cost of $3.03 per thousand, which I have rounded off to $3. That $3 is the unit that I have used in the detail I went over this morning as the labor crew that is working with the carpenters on the grade.

I have the cost of handling from the truck to the flume, as I explained this morning in two or three instances. I have it worked out for the flumes. The Pilarcitos, the Stone Dam Aqueduct, the
6236 first and second sections, the Davis Tunnel Flume, the Crystal Springs Flume, and the Sunol Aqueduct Flume. As to the labor cost of getting the lumber there, from my experience, the figures I gave this morning are my idea of what it would cost to sort it and pile it. The analysis as to the labor crew is for a crew in general on a 3 x 5 flume. The frame crew is $12. The labor crew, their foreman at $6 and fourteen laborers, I call it $3. This is the $3 I have used in each one of these.

6237 The Spring Valley flumes are as well built as any flumes have ever been built. In the first place, great care is taken in getting seasoned lumber into the flumes. Also great care is exercised to keep from putting in the water channel timbers that are checked on the ends in any way. Great care is taken, or has been taken in the handling of these, so that when these dressed timbers are put together they will fit exact, and that the edges will not be all battered off so as to invite leaks. When they are put into the flume the bottom boards are drawn together and tightly clamped, so as to have as tight a seam as it is possible to get. The post on the opposite side is put in on the ground, which insures, as I explained before, getting the gains in the proper place, and keeping it absolutely tight. Very rigid inspection has been used in the flume lumber. All lumber that is in any way undesirable is thrown out. In the water channel you have a perfectly clear lumber. The redwood used for posts and sills, etc., is first-class redwood. In the Oregon pine they take care that all knots shall be solid and no weakness introduced, which, with added strains, is liable to rupture the structure. The battens are put on in such a way as to keep the joints at all times covered with asphalt. Great care has been taken in

the caulking of the joints. Ships caulkers have been used in all cases. Whenever there is a bend, which is very frequent in these flumes, the edges of the posts have been chamfered or beveled so that 6238
the flume board or the side board of the water channel will fit snugly and properly against the post. The joints have all been mitred. You get as good a joint as it is possible to get. There is advantage in using seasoned lumber. If you use unseasoned lumber you are liable to have it shrink and warp on you and give you trouble.

Questioned by Mr. Searls.

These flumes are dry during a portion of the year. They are dry in part. At some times of the year they are running full, and at other times they are running partly full. That freeboard is always subject to drying and wetting. That is true of all of the flumes in the Spring Valley system. They try to overcome that by putting baffles in the flume, which is a very good practice, and thus eliminate some of that trouble, but not all. The Sunol Aqueduct fluctuates, but not as much as the Peninsula flumes. It would not be practicable to do your sawing and small work at San Mateo. In the first place you make your flume fit your grade. It is not a structure with regular curves and things of that sort. You have 6239
to try it out as you go along. You never know where to mitre until you have the location on the ground. 6240

Witness: F. A. Radle for Plaintiff. Radle

DIRECT EXAMINATION BY MR. OLNEY.

My name is A. F. A. Radle, age 49 last October. I am a right of way and claims adjuster, engaged with Sanderson & Porter, the engineering firm. I have had experience in purchasing rights of way. My first experience in actual action was in 1904. I was raised in the oil fields, and have seen pipe line work going on for years. I first began to purchase rights of way in September, 1904. I was working for the Indiana Pipe Line Co., at Muncie, Ind. I was there about 9 months. It would be pretty near impossible to say how much right of way I purchased there, for we ran gravity lines all along the oil fields during the excitement. It would probably run into the hundreds of miles. In conducting that kind of buying of right of way it is bought at a nominal figure first. Any damage by construction, which is paid afterwards, generally averaged in those small lines around 25 to 30 cents per rod. My next engagement in right of way work is in the northern part of Ohio. It was on what they call transcountry, and was away 6241
from the oil fields. I was buying pipe line right of way for oil lines. So far as the buying of right of way was concerned, I was

in charge. We bought about 136 miles. I had charge, with no assistance. I was next engaged in Kansas, I think, in the same line of work. I don't know how much right of way I purchased. There were other men on that job. I was in the locality about 65 days. I next went to Northern Ohio again on the same character of work, for subsidiaries of the Standard Oil Co. I was in the employ, practically, of the Standard Oil Co. all this time. I took up the same
6242 character of work when I went back to Ohio. I was there about a year or a little over, buying transcountry right of way. It was all on one straight line. It was the same line. We just doubled the 136 miles again. I was next engaged in New York State, Pennsylvania, and New Jersey. I bought pipe line right of way in all these states for the Standard. I have bought about 170 miles of right of way in California, purchasing for the Valley Pipe Line Co., from near oil fields to Martinez. The Valley Pipe Line is a subsidiary company of what is known as the Shell Co., I believe,
6243 and I am still working on it. I have been engaged on it since a year ago the first day of last April. I began purchasing on the 12th day of June a year ago. I purchased 170 miles. I was asked to make an appraisement of the right of way of the Spring Valley Water Co., and I inspected all available data, visited all the properties, as many as were approachable by automobile, and whenever there was a difficult place to get to I walked it and made a personal inspection. That is, on the ground as near as we could locate them from markings that existed. In making my appraisal, I tried to be governed by 1913, December 31st. I have had a tabulation showing the results arrived at by me compiled under my supervision. The tabulation which I have before me is the one to which I refer.

6244 Introduced and marked "Plaintiff's Exhibit 122".

Referring to page 1 of the tabulation, under the first column marked "Serial" it represents a serial of the parcels of property as near as we could arrive at it by maps in existence and approximation in scaling. It is a matter of reference. It puts down there in numerical order the various sections into which I have divided the particular pipe line right of way. In the second column, marked "Station" I have put the engineers' stations. I have then divided this pipe line beginning at section O, and ending at station 40 plus 68. The reason I mark a division of 40 plus 68 was because we were working upon the conditions that existed there. We were placing it in the zone for placing the values as we see them. I have included in each one of these serial numbers a section of the pipe line right of way, which for one reason or another I consider for
6245 appraisement purposes should stand by itself.

In the third column the figures refer to the maps. For instance there is No. 23 that we worked from. Under the column "Parcel" appear the parcel numbers which are given on these maps which

appear in Exhibit 8. The column headed "R. W."; the column headed "Prop. length, width", gives the right of way, private property, length and width, and under that is given first the length and then the width. The next column is headed "Right of way for- 6246
merly private property now public road". The third column is "Public Road". I have indicated in each instance under which of these three classes the particular section of right of way comes. By looking at this table you can ascertain whether or not it was right of way across private property, right of way across private property formerly, but now public road, or right of way in the public road. The widths in here are as of the data available, and the records, given some in one instance and some in another. Where there were no widths stipulated at all, we have taken 25 feet in width as about the practical width for laying a line of that size. Wherever the right of way had a definite width, I have computed the area of it upon the basis of that width. Wherever no specific width applied I have assumed a width of 25 feet. I assumed the width of 25 feet because it is generally what is considered to be the practical width for building a line of that kind. That width is necessary 6247
for delivery of material, men working, for excavating, and the injury to the property along the particular course where the pipe rests. That is custom, and is borne out by my experience.

My experience with water-pipe rights of way has been only on small lines in connection with fields, running all the way from 4 to 12 inches. My experience has practically been with oil pipe lines. Oil lines run in size from 3 inches to 12 inches. There are no 24, 36 or 48 inch pipe lines for oil. They have never laid any larger than 12-inch. The seventh column contains the acreage which I have computed upon the basis of length and width of right of way. The eight column is headed "Value per acre of abutting property". 6248
That column represents the values of the year 1913, as ascertained by special inquiry, and interrogation of the real estate men, and property owners in the various localities. The next column represents value of acreage and right of way on the basis of value of the abutting property, without any allowance for severance and other damages. It is a computation made from the seventh and eighth columns together. The tenth column shows severance and other damages. The last column, total value. It is the addition of the value of acreage of right of way on the basis of abutting property, plus the severance and other damage. It is the addition of the eighth and ninth columns. In ascertaining the value of abutting property we went to the community in the first place and sized up things in general. Any person that we happened to meet, or even went out of our way to get to, that lived in that locality, was then interviewed, we might say secretly. They didn't know who we were representing, or what we were there for. In many

instances we represented that we were out to purchase a line. In that way we thought we got a better price out of it than in any other way. That is, nearer true value. Then we took into consideration the cost of the pipe line, and we arrived at the price we deemed, backed by experience, ought to be placed on that property for this purpose. We made inquiry of others than those in the neighborhood of the line, such as real estate men that might be

6249 in that locality, and sometimes tracking out a transfer of property and seeing what it sold at. I personally went over every bit of this, but I had to have it compiled, and as I said in the beginning, under my supervision and jurisdiction and consultation, but I visited everyone of the properties. The mathematical work was done by an assistant.

Inquiries were made on my behalf by people in my employ, and I made some inquiry myself, and worked many times separately to get at a price that we considered to be right and just. The result of the inquiries were in every case submitted to you. I did not

6250 make inquiries in all of these cases, but in the majority of them. Most of the time I was present. I don't think there are over half a dozen cases where I was not present. I took in the conditions as they existed, as I stated previously, on a conservative basis. I followed in the matter of getting at values the same practice that I follow in actually purchasing rights of way, and arrived at a figure in each particular case as to how much I was willing to pay the owner.

6251 Station 40 plus 68, referring to table 1, is directly opposite where the county road crosses the creek as shown on that portion of the map which is at the top of page 23. The character of the country is a deep canyon. It is practically in the bottom of the canyon of the San Mateo creek, deep and narrow, and for that distance it is running over the property of the Spring Valley Water Co. I have placed a value of $150 an acre included in this right of way. I got at this value from interrogation and special inquiry. I made the inquiries myself. In the locality we found out

6252 that land of that nature is running at about that price.

Questioned by Master.

I have made all of these values upon my own judgment, and not on figures that were given me. Invariably they are a shade below all figures obtained.

Questioned by Mr. Searls.

I did not state that $150 was the value given me by persons from whom I inquired. I said that in the beginning I made my deductions from visiting the land personally after getting the special inquiry price, and then on my judgment set these values.

6253 I have had experience in the valuing of land for right of way purposes, in the same section of country I have been working in.

I have had tax matters to look after, adjustments of damages. I have to value land in the particular locality in which I am. One month I might be in New York, another month in Indiana. It has to be judgment. A decision of mind as to value. There is no other way in California for a man to get at the value of land, because there is not a deed on record as a rule which states the consideration. In each case the figure set down here represents my judgment of the value of the property that the pipe line passes through, and what its value is per acre. 6254

In the ninth column "Severance and other damages", and in the case of the figure of $200; there are some small trestles there of different lengths, which act as a severance of the property lying in back. For the purpose of arriving at this item, I took a strip of about 50 feet in each case, taking a separate footing. This one here, No. 1, 50 feet in width; there are trees that would have to be taken out of there; for the removal of those trees, plus the value upon the trestles, based upon 50 feet extra width for the length of the trestles, the value per acre is given there. The damage that would be done to the balance of the property was putting a pipe line through there. I have added nothing on account of the expense of acquiring a right of way. These items are simply the valuation of the property, plus whatever damage in my opinion would be done the property, and that is all.

Passing to serial No. 2, extending from station 40 plus 68 to 71 plus 57, on which I placed a value of $250 an acre; that is in private property to the west of San Mateo Creek. It is still a canyon. That appears on map 23 opposite the crossing of the creek by the county 6255
road. At that point the pipe line runs into the county road.

(Statement by Olney as to the situation of the Spring Valley's lands owned in fee, to which rights of way and riparian value may be attached.) 6259

DIRECT EXAMINATION BY MR. OLNEY. 6260

The right of way between stations 40 plus 68 and 71 plus 57 is partly in a wooded canyon. At the lower end, or nearing 71 plus 57 it begins to open out more. I arrived at my value of $250 per acre by the nature of the land. It is supported by the same process. The land is better adapted to villa sites and mountain homes. The figure of $195 for severance and other damages is on account of a short trestle in there, a square area the same as the other, trees that would have to be removed for an area of 10 feet in width, as we are bound to a ten foot width. I have next 5,290 feet in the county road.

In the next serial number I have 2401 feet, running from station 124 plus 47 to 148 plus 48. It begins at a point on the bottom of map 24, where the county road is indicated as crossing

the creek. That is where the pipe line leaves the road and keeps to the left. From there it runs to station 148 plus 48. That is at the point marked "Blow-off", and it is on the same portion of the
6261 map. It is just a few feet before you come to A.A. That portion of the right of way is opening out from a canyon into rolling land which could be used for diversified farming and fruit raising. I place a value of $750 an acre on it. I got at that in the same way that I got at my other values. I arrived at my $150 for damages on account of the number of oak trees that would have to be removed, which are prized very highly in that locality. The oak trees are there, and the pipe line is there, but it is impossible to build around the trees. As to some of them today they have grown right around the present right of way. My testimony is on the basis of buying a new right of way and putting in a pipe line.

Questioned by Mr. Searls.

The oak trees have had a great deal of their growth around the present right of way.

DIRECT EXAMINATION BY MR. OLNEY.

The next designation from station 159 plus 38 to station 162 plus 63, starting with "Blow-off", a short distance beyond the line
6262 A.A., that is described on the upper part of the map on page 24. I stopped at that particular point because of an angle there and a change in the condition of the property. I have placed $1200 on the property through which the pipe line runs. It is improved in that locality. It is right near the Howard residence. It is under some cultivation.

The next section of 325 feet is cutting right along the vineyard, 162 plus 63. The line to which you come upon the ground is the Howard property. That is what we assume is the Howard property line from the map, and conditions which exist there. I have placed a value of $1800 on that.

EIGHTY-SIXTH HEARING. JANUARY 25, 1916.

Witness: F. A. Radle for Plaintiff.

6265 (Certain corrections noted in the transcript).

6266 DIRECT EXAMINATION BY MR. OLNEY.

Serial 7, on page No. 1 of my tabulation "Right of Way for pipe line, 593 feet in length by 10 feet in width" runs within the bounds of the City of Hillsboro, crossing the private grounds of G. H. Howard, which are lawn and shrubbery. There is a private residence on the property. The pipe runs along one side of this residence. The lands

are well improved with drive-ways, and as I remarked, lawns and shrubbery. I arrived at my value of $3500 an acre from the abutting 6267
property by the same process that I followed with all the rest, which was inquiry, and making my own deductions afterwards. The damage of $300 is made up by injury to the lawns, and the removal of some shrubbery within 10 feet. I did not allow for any damage to the property by reason of the right of way being an encumberance or a cloud upon it.

Serial 8; a right of way 807 feet in length by 10 feet in width, is a kind of an open space. It is located at Hillsboro. The property is valuable for residence purposes. I arrived at its value in the same manner. The amount of $45 for severance or other damages is on account of shrubbery, and it goes along a hedge fence.

In none of these cases did I allow anything for damages on account of the right of way being a cloud or an encumberance on the 6268
title of the property.

Serial No. 9; a right of way 2813 feet in length by 25 feet in width, is in and along Occidental Avenue.

(Remarks by Master on "severance and damage").

Serial No. 9; the value of $6,535 an acre was arrived at by re- 6270
ducing the lot value of the property abutting to acreage. I have not allowed any damages in cases where the present right of way is now the public road.

Serial No. 10; a right of way 2104 feet by 25 feet in width. The value of $8,715 was gotten by reducing a lot value of $1000 to acreage.

(Discussion between Counsel in re reproduction value for rights of way).

Questioned by Mr. Searls. 6271

The difference in value between Serial 9 and Serial 10 is because the street was not paved in 1913; the price per lot also varies. I did not allow anything for paving over mains. In speaking of paving, I mean that the lot values are greater by reason of that fact.

Serial 11; a right of way 227 feet in length by 25 feet in width, valued at $6535; also runs along Occidental Avenue. I arrived at my value in the same way, by reducing it to acreage, basing it upon the lot value.

Serial 12; a right of way 252 feet in length by 25 feet in width; runs through the private residence property of Mr. Tubbs. The pipe line crosses just a small corner of his house. I do not remember the dimensions of the corner that it crosses. It was rather small. 6272

DIRECT EXAMINATION BY MR. OLNEY.

The length of the right of way is 252 feet. The $175 allowed for damages are for some small ornamental trees, from 1 to 5 inches in diameter; also damage for the lawn.

Serial 13; is a right of way 41,277 feet in the public road. It passes out of the Tubbs property into the public road, and then it runs for nearly 8 miles in the public road.

(Statement by Mr. Olney to the effect that he claims a value for right of way where the pipe was laid before the public highway was established, and no value where the public highway already existed).

(Statement by Mr. Searls to the effect that the company should be allowed the reasonable cost of a right of way acquired over land over which a road was subsequently laid down).

6273 DIRECT EXAMINATION BY MR. OLNEY.

We have already gone down past San Bruno on the Crystal Springs right of way.

Serial 14; right of way 1572 feet in length by 20 feet in width, is land situated near the City of South San Francisco, adaptable to truck gardening. It is a little southwest of South San Francisco. It
6274 is north of the town of South San Francisco. My value placed on the abutting land was $500 per acre. $100 for severance and damage is by the reason of about 20 gum trees there.

Serial 15; a right of way 596 feet in length by 20 feet in width, is rough. It is sheltered from high winds, and could be used for truck gardening. I believe it is being used at the present time for grazing.

6275 (Discussion between Counsel in re lengths of rights of way).

Serial 16; was segregated in Parcel 878, because of the difference
6277 in the nature of the land. The $250 for damages is because of a box trestle. It is a severance and an obstruction above the surface of the ground. The trestle does not cover all of that particular serial number. Serial No. 16 does not begin with the beginning of the trestle.

Serial 17; right of way 1738 feet in length by 20 feet in width. The value of $125 per acre on the abutting land was obtained by the same process that I used with the others. $30 damages was arrived at because of a short trestle across the gulch.

Serial 18; is 140 feet crossing diagonally the county road.

Serial 19; a right of way 1338 feet in length by 28 feet in width, is the same character of land as Serial 17. It is hilly.

Serial 20; a right of way 293 feet in length by 20 feet in width, is the East and West Portal Tunnel site. The tunnel extends through
6278 this piece. This portion of the right of way just covers the tunnel. It runs from one end of the tunnel to the other. I got at my valuation in the same way. The $40 damages was because of the waste dump in the tunnel.

Serial 21; a right of way 429 feet in length by 20 feet in width, is in a public road. That is, a street, or something of that nature.

Serial 22; the notation referring to the land which reverted back
6279 to former owners, has reference to the abutting property.

(Discussion between Counsel in re Serial 22).

Serial 21, on which I placed a value of $400, slopes down from the hills to level bottom land, a kind of a gradual slope. There is very little settlement in that immediate vicinity. The locality is called Visitacion.

Serial 22 is good tillable land for diversified farming, or for building lots in subdivision. It is in Visitacion. "Road over box pipe" noted in the margin means that this street or road goes right over the box pipe as it comes through there. I think it is 79 feet in length. The box crosses the road.

Serial 23; a right of way 80 feet in length by 20 feet wide. The pipe line comes off the county road and cuts across a corner. I got 6280
at the value of the abutting land in the same manner. $40 damages was for severance of the corner of a part of a trestle. There is a trestle at that point which cuts off a corner of the property. The $40 is arrived at by the area that is in this triangle. There is about ⅛th of an acre that is cut off. I used an acreage value of $300.

Serial 24; a right of way 40 feet in length by 20 feet in width. It is a right of way formerly private property now public road that crosses the street there.

Serial 25; a right of way 1761 feet in length, by 20 feet in width. It is not the same character of property as the serial numbers immediately preceding. It is rather swampy at this time. The value is for commercial purposes after being reclaimed. I arrived at this value by interrogation and inquiry, and deduction of my own. The 6281
pipe is laid above the ground on a trestle. I have $1212 as damages. This was computed by taking a strip 100 feet wide west of the trestle as being severed. The reason for taking the strip 100 feet wide is because that is the average depth of the lot. I felt that that was about all that would be affected by the trestle severance. The streets could be laid out parallel with, and in such a shape as not to interfere with more land than that. There is a county road running along the west side that would affect the problem. It is very crooked. Some points are close to the trestle and some quite far away, making those unsalable.

Serial 26; a right of way 1763 feet in length by 20 feet in width, is hillside. I got at my value in the same way.

Serial 27; a right of way 2522 feet in length by 25 feet in width, is sloping. It could be cultivated. I got at my value by the same process.

Serial 28; a right of way 562 feet in length by 25 feet in width, is land in use for dairy purposes, fairly level. 6282

(Suggestion by Mr. Olney for shortening right of way testimony).

Questioned by Master.

My value for rights of way through cemeteries is based on the lot 6284
value per square foot. I throw into acreage the area, the price per acre based purely upon lot values. In some of the cemeteries they do not deal in lots at all; they sell by the square foot. They will sell you

any area you wish according to the square foot basis. My computations are made by multiplying the retail square foot price by the number of square feet in an acre.

Questioned by Mr. Searls.

In city lot valuations I ascertained as near as possible the size
6285 of the lot. If it was 25 x 100, it would contain so many square feet, then I figured out how many of those lots there would be to an acre. I took the conditions just as they exist, showing the street separate from the lot.

DIRECT EXAMINATION BY MR. OLNEY.

The whole thing is on an acreage basis.

Questioned by Mr. Searls.

The value of the streets is absorbed in the lots.

Parcel 200, Serial No. 32, where the Spring Valley Water Co. owns certain lots on the north side of Wallbridge Street, which it uses for right of way purposes; my value was arrived at by the fact
6286 that those lots run 25 x 112½, \$450 each, 15 5/10 lots per acre. I took the actual value as I found it, of that portion of the right of way which was included in those lots, and I merely reduce them to an acreage basis.

Questioned by Master.

The acreage value for those lots is \$6,950. I multiplied 450 by 15 5/10.

DIRECT EXAMINATION BY MR. MCCUTCHEN.

This is the retail value of the lots after the streets are taken out. The right of way does not pass through the streets; it passes through the lots. In other words, all the land in this right of way is net land.

(Discussion between Counsel as to Radle's method of valuation).

6287 Serial No. 48; lots 23 and 29, in Block 4, are 25 x 100; \$200; 17.424 lots to the acre, and worth \$200 a lot. In valuing, I held to acreage from the beginning, holding to acreage is a uniform figure to work on all the time. These lots have so much area in them. They are 25 x 100 feet. We reduce that to acres, and multiply the number of lots that would be in it, 17 and a fraction lots to the acre. I have seven lots there. They are worth \$200 a lot, if you want to place it
6288 on that basis. I could go out and buy them for \$1400. I have \$1751 here. That may vary a trifle in one instance, and be reversed in another one. It is an equalization. There is nothing more equal than to reduce everything to an acreage basis. I have cut out the streets. As to figuring on seven lots at \$1400, and then reduce that to an acreage that would not bear out. If you bought a right of way in diagonal through those lots, and undertook to dispose of them, the price would be reduced.

EIGHTY-SEVENTH HEARING. JANUARY 26, 1916.

Witnesses: W. B. LAWRENCE for Plaintiff.
GEO. L. DILLMAN for Defendants.

(Agreement in re Pleasanton and Alameda lands, etc.) 6291
(Agreement in re Lake Merced Lands.) 6292
(Tables of miscellaneous cost data submitted by Mr. Metcalf.)
(Discussion in re Lawrence's testimony on motor trucks.) 6294

Lawrence

Questioned by Mr. Greene.

The latter figures on my table referring to work done by the Company are taken from the company's records, as to hauling to Calaveras, and the other records were obtained from information from Mr. Peckham as to what they did on the De Guigne road. I have had very little experience in motor truck hauling. Most of my hauling 6295 has been done by team. I have had very little experience in motor truck hauling, probably one or two trips to Pilarcitos by motor truck around the dam, but nothing that I could use. That portion of my testimony, so far as hauling is concerned, is based either on costs that were obtained from the company or information I obtained from others.

CROSS EXAMINATION BY MR. SEARLS.

The figures on "H-6" and "H-8" are based in part at least upon the information that I had from Mr. O'Shea and Mr. Peckham, and the San Mateo Development Co. (Sheets "H-6", "H-8" and "H-1" 6296 exhibit 109 stricken out by order of the Master.)

All the data on sheet "L-1" was obtained from the Spring Valley purchasing agent. He furnished me the data.

(Volume marked miscellaneous cost data marked "Plaintiff's Ex- 6297 hibit 123".)

CROSS EXAMINATION BY MR. SEARLS.

The price of lumber on "L-2" is based on information given on "L-1". The labor on flumes which is shown on "L-3"; I have taken present flumes which were built on an 8-hour basis and resolved them into 1913 wages, retaining the 8-hour time: and I have taken certain flumes which were built on a 10-hour basis and resolved them into 1913 wages and 8 hours time. I assumed that a man would perform 8/10ths as much work in 8 hours as he would in 10. On the second item, the Pilarcitos Aqueduct, the fifth item, the Stone Dam Aqueduct, and the 6298 sixth item the Stone Dam Aqueduct; I don't state there whether there was 8 or 10 hours worked on there, and I don't recall that now. I have that "F-5" here. I have must have worked 10 hours on that, because 20½ days work was resolved into 25 days of 8 hours each. The fifth item on "L-3", the Stone Dam Aqueduct, is a 10-hour day also, and the sixth item is also a 10-hour day. 6299

(Certain computations on flume labor were made by Searls and checked by Metcalf.)

I don't think that the computations make a difference of $4 per thousand between my weighted average on a direct resolution of the 10-hours into 8-hours, and my weighted average of the 8-hour day where no resolution is necessary, using the same wages in both cases. This does not indicate that I cannot fairly resolve the cost of work originally done on the 10-hour basis into the cost on an 8-hour basis by taking the direct ratio of 10 to 8. The first one you have, is the Pilarcitos side flume, which was a very cheap flume, and also you have the last one, which is also a very cheap flume to construct. You have the cheapest flumes, as I understand them. The Pilarcitos side flume was one, wasn't it? I didn't mark them here as you read them. You picked out on that the smallest flumes that we had. You might have taken all the flumes I have, but on the 10-hour extended basis the
6300 largest flumes were constructed, and then for the direct basis the smallest flumes. It makes $22.50 against $18.60. The Crystal Springs Pump Flume is a small flume. It is a long one, but it is small in size. Small flumes are not more expensive per thousand to construct than large ones. I can't make it out from my experience that the small ones are. It is not so that the higher the proportion of framing and work of that sort the less it costs. I have the reverse. Take the Pilarcitos side flume; there are no gains in the caps or sills. The labor element is eliminated there, and the accessibility is another proposition. On the Pilarcitos Aqueduct, where it would cost $27, and where there are 101,000 feet, there are gains in that, and that cost more than the Pilarcitos side flume. That is the larger flume, and it cost more per thousand. The $23 flume that was built on an 8-hour day is a smaller portion of the Pilarcitos Aqueduct. That had gains in it, but it is a smaller flume. The Stone Dam feeder flume which cost $26 a thousand
6301 is a very small flume. I don't think that the proportion of cost of trestles and gains was higher per thousand board feet than it would be in a large flume. You have to consider the location of the flume. There is an element of packing lumber. In the Stone Dam feeder there is an element in there of lumber packing. I have that prepared in another way in my endeavor to get something tangible out of it. Take the Pilarcitos side flume; the carpenter cost there, per thousand feet board measure, is $7.01. On the Pilarcitos Aqueduct the carpenter cost is $16.95. That is the resolved cost taken from the original cost figured from data I have given you here in these sheets. I think I can compare my original construction cost on that basis. The original cost and what we could assume we could obtain the labor for in 1913. I was not referring to the original difficulty of construction. That is resolved into my 1913 schedule, expanded to that. I think that the work a man will do in 8 hours and 10 hours is the
6302 direct ratio of 8 to 10. Men don't have to work 12 or 16 hours now.

Questioned by Master.

I don't think there is any loss of efficiency in the change from 8 to 10 hours. I have had experience with men under both hour schedules. There is no way I can form a determination on that except by observation; just my judgment. I don't think labor is as efficient today as it was in 1898 and 1900.

CROSS EXAMINATION BY MR. SEARLS.

I am talking about ordinary labor. I won't say that about carpenter labor. I have not observed that. The statement I have just made regarding the efficiency of labor I think would also apply to skilled labor. I have not observed that as closely as I have ordinary labor. I have not employed a great number of carpenters recently.

Questioned by Master.

On a 10-hour schedule the hours would be from 7 in the morning until 6 in the evening. That is from 7 until 12, and from 1 until 6.

Questioned by Mr. Greene.

On an 8-hour schedule the hours would be from 8 to 12 and from 1 to 5.

CROSS EXAMINATION BY MR. SEARLS.

On sheet "E-4" there are some matters omitted, and there are 6303
corrections to be made on that. I don't know how it occurred. I suppose it was in typing it. In the percentage of increased cost the original cost of that was \$12,768.65 as against \$18,996.63. I have a sheet showing the detail of that. The percentage there in that increase would be 87½% as against 24.7%.

The original error was made in typing that from the sheet. They used a figure that we had down there some time ago, and it was not the correct figure. Only the total was used. I did not discover it 6304
until a week ago when I was looking this over. It was not used on this sheet 4. The 87½% applies to all that cost, foreman, labor, carpenter and teams. The principal increase is in the labor cost. From these extensions labor has increased 87½% since 1898. In 1898 we paid \$1.64 for labor. That included board. We paid \$1.15 plus the board, or \$1.64 with the board. Today that same labor is \$2.50. That would be the principal increase.

Questioned by Master.

On the inventory the \$23,938.37 includes the clearing of the ground through which this excavation was made. The inventory shows that to contain 25.1 acres. I have estimated the clearing of that at 6305
\$70 an acre. The total is \$1,760, which I deducted from \$23,938.37, which gives me \$22,178.37. The item of \$23,938.37 is marked as covering clearing and grading.

CROSS EXAMINATION BY MR. SEARLS.

In my 1913 hours I have taken a straight 1913 wage schedule. I have not given any consideration to any wages between 1907 and

1913. I don't think you could obtain good labor for $2 a day in San Mateo County for 10 hours. I understand that the corporations down
6306 that way are paying $2.50 for labor 8 hours. I don't think you could get labor for $2.50 between 1906 and 1913. We first paid $2.50 in 1902, if I remember correctly, or the beginning of 1903. We paid $2.50 a day for 8 hours. I don't think that during 1909 and 1910 you could get labor in San Mateo County for $2 a day to work 10 hours. I figured on the best class of labor obtainable; good, strong huskies, any nationality. If I picked out good men from any nationality they would make good common labor. I don't think you could get efficient labor to work 10 hours for $2.

6307 In San Mateo County in 1907 we laid the Merced branch of the San Andres pipe line. That was one of the large jobs.

Questioned by Mr. Greene.

We paid $2.50 a day for labor there.

CROSS EXAMINATION BY MR. SEARLS.

That was done in the Summer of 1907, if I remember correctly, or in the Fall. I think it was completed in 1908; I am not positive as to that. I don't know of a considerable decrease in the price of both commodities and labor in the Fall of 1907 and for a year or two following. We didn't experience any such decrease in our end of the business.

Questioned by Master.

Ordinarily when there is no extensive construction going on, we have in San Mateo County about 15 or 20 common laborers employed. In the reconstruction of this plant in San Mateo County during the period in question I don't think we could attract more laborers of a good class and that the price might be less. Take the railroad, for instance, and I base it on that; laborers were working on the railroad in section gangs—it is true I have not timed them as to actual
6308 work they did, or rather that they accomplished, but it is cheaper labor than we employ, and in my opinion they don't anywhere near accomplish as much work as the laborers we employ. The laborers we have under ordinary circumstances to do maintenance work stay with us year after year. If there was a general depression all over, I suppose you could get good men for the highest price. I believe in paying good wages for labor. I believe you can get better results, and that your work is more economically constructed.

CROSS EXAMINATION BY MR. SEARLS.

6309 Mr. Ellis: During 1908 I was building the Crocker tract, which lies right in the northern part of San Mateo, almost abutting the county line. In fact, it was so close to San Francisco that I had my camp in San Francisco at an old roadhouse right across the line. We worked 9 hours, which was acceptable. There was no question about

it at all. I could get all the common labor I wanted for $2 a day during 1908. I had the pick of men. I had on my trenching gang I think the best gang of trenchers I have ever seen. This is evident by the cost of excavation. I cited some of my trench costs in sand, which I think ran along about 15 cents a yard, which is one indication of the quality of the labor. For men putting on rough lumber, such as curbing, we paid $2.25 and $2.50, and so on. The largest part of the work was common labor and teamsters. This was grading, sewers, sidewalks, etc. So far as having any labor trouble was concerned, I always had about twice as many men making applications for work as I had work for. At the same time, the proximity to San Francisco had no affect at all. Quite a number of the men who did not board at the camp lived right in San Francisco. I did not have any trouble with labor leaders. If any came around they would not have been tolerated. They would have no effect. There were no labor leaders among common labor. Labor leaders didn't have any effect on common labor when I was working them in San Francisco in 1907, in the boom times.

Questioned by Mr. Greene. 6310

In 1908 wages dropped 25 cents on that same work, when the panic came in 1907. The work started in the middle of 1907. They were paying $2.25. Wages dropped to $2. The panic came along in about October or November. During 1908 labor was $2 on the aqueduct.

Questioned by Mr. Searls.

I went south on the aqueduct and did not return until 1911. On one job across the bay I happened to be familiar with they were paying $2.50 for 10 hours on the Oakland-Antioch. When the same outfit took up the Richmond Tunnel work they paid $2 for common labor. They paid $2 at the start. I think they subsequently increased it on account of some friction with the municipality. That was 8 hour a day municipal work.

Mr. Lawrence: Referring to sheet 2, the price for excavating solid 6311
rock and loose rock; where I derive the price of earth from those two, is an assumption. If you shift that around there is a total cost there of so many dollars for so many cubic yards of solid rock, loose rock and earth, and I really put those figures down from my judgment what it would be.

Questioned by Master.

I have assumed from my judgment the solid rock, the loose rock, and the balance of the earth. That is all that indicates.

CROSS EXAMINATION BY MR. SEARLS.

I had no data showing any segregation of cost on that. The grading was practically all hand work. We tried to use a plow, and it did not prove a success, and we used some powder on it. I do not think

it was possible to use plows and scrapers, owing to the flume grades being so crooked. Another objection to scrapers would be in going through private property. I have in mind the Mills and Easton properties. They would object to working scrapers going beyond the right of way which the flume was confined to and turning around. I don't know whether that was the case when the Crystal Springs Pump Flume was constructed. A portion of that was built along the old grade, and that was excavated, I was told, that was long before my time, by hand, also, pick and shovel work. I don't think scrapers
6312 were used much then. In our extensions of that in 1898 the portion we built was by hand work also. It was not practicable to use plows and scrapers. You see a plow with a six-horse team on it going around the sharp bends in a flume does not accomplish a great deal, and then you have to make your fills where the little trestles are in order to get the full team over, or else they have to turn around, and a plow team in turning around would lose a whole lot of time. I don't think there is any great stretch of earth there, but what there is has some rock in it, and a light two-horse plow, if you strike a boulder, goes to pieces. We tried that first in the San Mateo Creek. We thought when we started we could use plows to loosen up and then shovel off in those steep places, but it did not work out. Speaking of the Pilarcitos side flume, sheet "F-2", that flume was rebuilt in 1909 and 1910. In the increase of cost to the 1913 basis there is very little difference. There is a little increase of cost of the foreman; the laborers the same; your two-horse teams increase a little.

We don't employ any general construction foreman at the present
6313 time. The basis of my present wage schedule for foreman is $6 a day, foreman carpenters. The job on "F-2" was not an extensive job building this Pilarcitos side flume, and the foreman was a monthly man at $90 a month, and in expanding it I used $4 a day. In getting the $4 a day for 1913 I expanded it. $4 a day would be a little more than $90 a month. I have the ordinary foreman on a job of that kind at $4. I did not employ any at that price in 1913.

Questioned by Master.

That is my judgment as to what a foreman would cost in 1913, if he was not on a monthly basis. You might possibly get one for $90 a month in 1913, but I don't think so.

CROSS EXAMINATION BY MR. SEARLS.

6314 I did not have occasion to hire any during 1913. My opinion in that respect for that year is based on judgment. Referring to "F-2", the one item of $4 a day is a carpenter that had practically steady employment up to that time, and he was put on this flume, and I estimated that to get a man to do that that did not work for us right along you would have to pay $5 a day. This man had been with us for years. All carpenters employed in reconstructing these flumes

would have steady employment for some period of time. You would have to pay $5 a day for that. As to the 71 days, I don't know if that just represents one man; it may represent two. I think practically one man. The $4.80 also, if I remember correctly, is another man. The 32 days for foreman is all right. The job was split; part was done in 1910 and part in 1911. I don't know as to that 32 days. I can't recall now that that 32 days the foreman was on the job continuously or not. We had a small number of carpenters building the flume. I don't know how many. I have not looked that up. On page "F-3" I have done the same thing with respect to the carpenters 6315
building the trestle. When the work was done we generally had one carpenter in charge of the work who laid out the flume angles and all that sort of thing, and the other followed along and laid out the intersecting sills, and the laborers would put in the sills between the intersecting sills, and then there followed another one along who put on the bottom boards and sideboards and tops.

Questioned by Master.

The carpenters would do all the work Mr. Searls speaks of. The carpenters would do the mitering. Probably on this flume there were two carpenters doing it.

CROSS EXAMINATION BY MR. SEARLS. 6316

I think in this case the nailing was done by cheaper labor.

Questioned by Master.

Not by the carpenters, but the fitting was all done by the carpenters.

CROSS EXAMINATION BY MR. SEARLS.

I think on work of that character it pays to pay the carpenters that lay the intersecting sills more than you would the other carpenters, because the progress of the work depends upon them. Then probably the next two carpenters should receive more than the others to keep up the others that have got to follow.

I have heard of rough carpenters, but we designate them as little better than laborers for driving nails or something like that, who are paid a little more wages than laborers, but not as carpenters. There are such men who are learning the carpenter trade, but who have not obtained the skill necessary to get regular carpenters pay. I have heard of them but have had no experience with them.

My increase in the cost of teams is on the ground of establishing a schedule for wages in 1913. I used the increased price as being the prevailing price for teams as near as I could ascertain. The price of 6317
$3 a day for 2-horse teams includes the wagon, probably, or something else. I did not figure on a teamster. My wage schedule is on "W-1". In other words, I figured the teams with the teamster. I don't know what the rate of teamsters was. I have got one working for me steady, or did have up to a short time ago, and I think I paid him $60 a month

and his board, which amounted to about $22 a month. That would make it about $2.75 a day I should judge. This man didn't work on
6318 Sundays. You might get teams for $5.25, but I have taken there the prevailing wage in San Mateo in 1913 for teams. If a contractor brought in a lot of teams which belonged to him from some other county, he might get them for less than that. That might be the logical way for a contractor to do, but I would not use that as an estimate in estimating. I did not use it. I have here a note; the average price in San Mateo County for 2-horse teams, 8 hours work, $6 a day, out of which the teamster is paid $3. That is the union scale of San Mateo. That is what I was told, I think, by a party that has a number of teams there.

(The last answer objected to and stricken out.)

6319 I am familiar with the matter on "H-3" referred to on "F-4", loading and unloading piling. The information was obtained from Peckham & Co. I think that on the lumber proposition I have not looked over this for some time, but that lumber was taken from the Calaveras Dam, loading and unloading. I would like to compare that and see whether that is so. I haven't any record of the time of unloading in my own experience. I have not followed that closely. The handling of lumber was done by men whom I employed, but I ob-
6320 tained this cost of loading and unloading—I think I have taken into consideration the Calaveras job, and then the information as to the rest of the materials from Peckham & Co., the people who handled the matter. I have not any record of the loading and unloading. It was done by the men in our employ. It is not possible that the costs which I have for handling lumber includes the cost of loading and unloading, because the cost I have used for lumber in this proposition is quoted f.o.b. cars Millbrae or San Mateo; nor is it possible on the labor costs on these flumes, or any work of that kind. I think I have some little data of unloading that we kept at Sawyers Camp in my records, but other than that I have not anything that is tangible. I don't think it is possible that these records of labor done on the flume include any time spent by the men in unloading the lumber which was put into the flume. I will look at it, and am quite certain it does
6321 not; I will verify that. Take that Pilarcitos job. There is an item there of loading, unloading and piling, Pilarcitos side flume, less labor piling lumber, removing old flume, clearing off grade, tarring flume, trestle piers, etc., referring to "F-4". On "F-2" the item "Taking lumber to feeders" was taken from the time-books. I cannot tell at this date whether the men who took the lumber to the feeders did not unload the teams. You take on that same page, "F-2", piling lumber, there is an item. I think we deducted that when we came to a certain proposition in this Pilarcitos side flume. On page "F-4" that is deducted. We did not deduct carrying lumber to the feeders. That is another item that has nothing to do with the teams. On the

other flumes I think I have made deductions where it was figured in. I don't think there is any time where men who are employed as laborers and carpenters helpers were included in the unloading of teams. I am quite positive of that. By looking over this you will see on 6322
"F-6", Pilarcitos Aqueduct, piling lumber is $29.38, that is deducted. The time of the men that did the work I think is all in there. It is deducted. Where the lumber was piled and dumped by the teams, and taken from there along the flume, that would be the flume cost. That isn't in the hauling at all. There is another one on "F-6" for piling of lumber. Gulching lumber is another item. We did not load any wagons with that. That is the item we are discussing; loading and unloading. We unloaded them, but we did not load them. On "F-4" the summary of my labor cost on construction was $16.57 a thousand on clear redwood, in 1913, on all the lumber at the bottom of the page there. I don't think that $15.20 would represent the cost of erecting these flumes in 1913, because it states here that the labor on that flume was $16.57, and how it was obtained. I think the $15.67 is nearer the actual cost in 1913. It figures out that way. I have not 6323
checked it up. I have taken what the figures show. The figure of $3.15 at the bottom of the page, extra cost for clear redwood, includes an extra width. Ordinarily flume lumber is 2 x 12. On this flume a portion of it is 2 x 16, and for that additional work you have to pay an additional price, which averages $3.15 a thousand owing to the additional width of the lumber. I based that upon the 10% advance and the 20% advance from information obtained from planing mills.

Mr. Ellis: The usual thickness is 12 inches in width. 18 inches 6324
is more usual than 16. 16 inches is an unusual width. I have never used it. I am not familiar with these redwood prices. I don't know anything about the local market. It is true of pine. There is an advance in price as lumber goes over 12 inches.

Mr. Lawrence: In resolving a 10-hour day to an 8-hour day from 1902 to 1913, page "F-5", I have not assumed an increase in the size of the gang or the length of time on the job. I did not consider the increase in foreman hours. I took the actual time and expanded it without giving it consideration. You would have to give them an additional number of days, take longer, or employ more men. It might be more economical to employ more men and use the same number of foremen, but I did not consider it. I did not try to make this job cost 6325
as much as possible. Whether the work could be done in the same number of days with a few more men employed would depend on circumstances, and I could not answer that without giving it considerable thought. The difference in labor days between 1902 and 1913 would depend on circumstances, on the consideration of that particular job. The same foreman might handle it.

The item on "F-4", "Lowering the grade 50 cents per thousand", 6326
was estimated on the basis of some records that we had where we

have lowered grades. That was what in our opinion would be a fair cost for that. It is an estimated cost.

Page "F-15", next to the last item, there is the word "grading" opposite that $818.74, which I think is for some of the changes of grade. I could not tell you now what it is. I will have to look it up. The
6327 Crystal Springs pump flume was built on an old grade. Referring back to "F-5", where I have a cost of 50 cents a thousand lowering the grade on 2135 lineal feet for 101,000 board feet, and which you figure at 2.3 cents per lineal foot; that is 9.1 cents per thousand feet board measure flume, whereas, on the Pilarcitos Aqueduct we have 50 cents per thousand feet board measure. It figures 2.3 cents per lineal foot. This depends on the amount of work. I don't know that that first figure was entirely for that at this time, or what this
6327½ other included. I understand from you that you say that 9.1 cents was per lineal foot, and the last figures are also per lineal foot. The different figures are for two different sizes of flume on that last proposition.

6328 Questioned by Master.

I verified the figures as to the cost per lineal foot for the various estimates of grading that Mr. Searls referred to this morning. The $818.74 is correct, but that included some sloping of the bank along there; how much I cannot state, through the wooded part of that flume where it passed through some woods. The other figure of 50 cents per thousand feet board measure, I took, considering portions of the flume that did not require grading, as being a fair figure for that work.

CROSS EXAMINATION BY MR. SEARLS.

The $818.74 includes the grading and the slight sloping of the bank where the flume passes through some woods. There is an old flume, original Locks Creek flume, over a portion of this line we have under discussion. We removed that flume and lowered the grade slightly where it passes through some wooded portion of the country, and sloped the bank a little bit. I mean by the wooded portion some little clumps of trees that are now standing on that side of Crystal Springs Lake. I stated that I didn't know but what there was a change of location, but I haven't any map here to show that. I think
6329 it was probably built along the original line, except for a few trestles. It is a slight lowering of the grade. I think it is comparable to the 50 cents per thousand feet B.M. In other places there was no grading. In portions of the other flumes there was no lowering of the grades, or only slight grading, no widening of the grade. In my judgment I think that it is a fair figure for that. The 9.1 cents cost includes the sloping of the inside bank where it went through some woods. It is cutting down the inside bank a little bit, and throwing it over on
6330 the outside. I have not the cost; the 50 cent figure I think would be

fair. It was simply my estimate. On "H-3" the reference to "H-1", which refers to the time it takes to load cement, crushed rock and 6331 lumber, I think the lost time was taken from the Calaveras job; from our records on that. In making up sheet "H-3" I think we relied on information of other companies as to the length of time to load and haul in the matter of brick. If I remember correctly on the lumber proposition, we took the loading and unloading from Calaveras. That is right.

On "F-7" the 2 x 6 beam, 20% item is clear redwood surfaced one side and two edges. The $1.96 is the 20% increase for unusual sizes. This information was not obtained from the purchasing agent. As to the extra sizes, that was obtained from a planing mill.

On "F-9" the difference between carpenters wages, $3 a day in 6332 1902, and my rate for 1913, is justified. $3 a day and board was the prevailing price for carpenters at that time. $3.50 a day was without board. It does appear on my exhibit. We charged 60 cents in 1902 for board. You will notice on the bottom line 1357 days at 60 cents. If you add that to $3 it will make $3.60.

I estimated a 50 cent price for lowering the grade.

On "F-17" the $826.68 for grading is on the reconstruction of 6334 the Niles Aqueduct. I think we have deducted that. I think we have taken off on the next page $960.93. That was widening a cut from the end of the Stone Aqueduct west, probably 600 or 700 feet. This was very expensive grading. The flume as originally constructed was between two banks, and when I reconstructed, in order to give the flume plenty of ventilation, I widened that out. It was very expensive work. It is not at all comparable.

On page "F-20", the grading on that flume and the construction of the flume were not separated. I don't think you could segregate it, so that it would show how that would compare with my ordinary labor charge on flume construction. "T-22" and "T-23" referred to 6335 trestles and housing on the San Andres pipe line, the Merced branch.

Questioned by Mr. Greene.

The cost on "T-22" would not be of any assistance in determining the cost of trestle work for flumes. I don't think we included it.

While we were on the subject of pipes we brought up the question 6337 of carpenters and laborers on the 44″ pipe, and there was a question as to what amount of lumber there was in the inventory, bringing the carpenter cost of to $230. I prepared a statement on that.

In the labor schedule on this job there were 544¾ days carpenters time. This time was not distributed over the different portions of the work. The distribution is assumed for this sheet. The amount of lumber listed in the inventory of structures would indicate that there is not merely this amount of carpenter work, but the inventory does not show the amount of lumber used in building forms for concrete piers, anchors and blocks, repairing and building fence, building

bridges for road crossings, over pipe trench, etc., and the trestles between Tanforan Park and Baden, which are now buried by fills for the state highway, and not included in the inventory. The bulkhead
6338 to keep the county road south of the Baden crossing from covering the pipe crossing was also omitted. The following is the summary of the lumber in place in trestles and bulkheads only, as it was built in 1898. Then I enumerate these things. Trestles No. 4, 1777 feet B.M., and then the different trestles are enumerated, making a total of 70,973 feet B.M., which is greatly in excess of what is in the inventory. There was no distribution of the carpenters on the job. The carpenter jobs are included in the cost of the pipe work, which include these buried trestles and other structures which are not included in the inventory. A lot of the trestles were omitted, which brings it up to 70,973. You figure the cost per thousand feet B.M. per carpenters day labor as being $230. That seems exorbitant. Now you add in all the structures that you actually constructed in 1898, and it brings you down to $48. That does not include all the work either, work that I cannot measure and don't know. I have some photographs here as to what was constructed at that time.

6339 RE-DIRECT EXAMINATION BY MR. GREENE.

As to original costs, I think I have given everything that we have so far.

I think a 3 x 5 flume is about the average of flumes of the water company. On the construction of a flume of that kind I would work about 20 carpenters and 7 laborers, and in addition to that a variable amount of laborers to pack lumber. That varies according to location.

(Suggestion from Master as to the testimony of the Spring Valley purchasing agent in re prices of materials obtained by witnesses.)

Dillman Witness: Geo. L. Dillman for Defendants.

6343 CROSS EXAMINATION BY MR. GREENE.

My eulogy was not on the Oakdale Flume. My eulogy is on the Hilt Sag Flume. I didn't build as good a flume as that. I never built as good a flume as that. If I have my own way, I never will build as good a flume, because it is entirely beyond the necessities of the case. The Spring Valley flumes are good flumes. I take no exception to their manner of construction or the quality of the material. They are not as expensive material as the Hilt Sag Flume, with respect to caulking, and they give no appearance of being as well done. The Spring Valley flumes are well done for the purpose. They are probably better flumes than I would build in that case. The caulking in the Hilt Sag Flumes has deeper seams, and it was caulked more fully than the Spring Valley flumes. The seams in the Spring Valley flumes are not caulked full.

Questioned by Master.

When I said that the Spring Valley flumes are better than I would build I did not mean that they were better than I figured to build in this estimate. The figure that I have given, in my opinion, would build the identical flume.

CROSS EXAMINATION BY MR. GREENE. 6344

I wish to stand by my segregation of the total cost of $45 or $40, which I gave the other day. It is as good a segregation as I can make. In reaching my figures I did not have any of the costs that were actually expended by the company in the construction of the flumes in question. If I had had those costs, they would not have influenced me. The reason I ignore the Spring Valley Company's flume cost is because of my connection with the construction of timber work of that character, and I have a definite idea of what it would cost under my supervision, and I am better satisfied with that than with any hearsay evidence as to the cost of flumes built by somebody else by some other method. I did not have the company's books showing what those flumes actually cost. I would ignore them, because I know what that kind of 6345
work should cost, and what it can be done for. I would prefer to rely on my own judgment, where I have had experience, rather than on somebody else's.

(Discussion between Counsel in re availability of cost data, which Mr. Searls said he could not get from the company.)

CROSS EXAMINATION BY MR. GREENE. 6346

I think I examined the Spring Valley flumes sufficiently to get all the information that was necessary. I got no other information than the inventory and the inspection in the field. After that inspection I fixed upon a sum of $40 or $45, as the case might be, as an appropriate figure. That figure is based on my experience in flume construction, trestle construction, and culvert construction, all included in what is generally called bridging and general contract. The cost of the work is usually put down in those estimates as so much in the finished struc- 6347
ture. I have spent a great many years of my life in handling that kind of work. As engineer designing and inspecting and supervising construction, as contractors engineer, as contractors superintendent, and as contractor myself, supervising my own work. This is not different, except in the quality of material, from ordinary bridging, including those three items, flumes, trestles and culverts in an ordinary contract. I relied upon my experience and knowledge of costs that had been gained in other work that I considered similar. The Oakdale flume was the most recent flume construction that I was intimate with, the price of which I knew. I have not kept records of the cost of construction to a very great extent. I discarded those records some time ago. The Oakdale flumes are the most recent. They cost $40 per thousand in place. The flumes for the Rio Bravo Ranch were put

in by me, and the work was laid out, and the lumber purchased, and the work was supervised by me. I was on the work every week, frequently for hours during the day. I handled the accounts from start
6348 to finish. It was a flume built in 1894, on the Rio Bravo Ranch, about 20 miles east of Bakersfield, on the Kern River, on the north side. There is where I got most intimate acquaintance with flumes, because that was my work from start to finish. At the same time, that work is not segregated, nor do I now know the total cost. I kept no data. I don't want you to think that the matter is all guess work outside of that, because I have had very close connection with a good deal of work and kindred work on the cost. There was the Hilt Sag Flume; I had that definite information. As far as work is concerned that I supervised myself, the Oakdale Flume is the only one I can think of now where I have a definite knowledge as to the cost. When I estimated the Spring Valley flumes, I had no other data based on my own experi-
6349 ence, except the Oakdale Flume. It has been some time since I saw the Oakdale Flume. I can get the information as to length for you, and I can have it here tomorrow morning if it is a matter of importance. Your information as to the flume cost of $60 a thousand paid in bonds is incorrect so far as contradicting my statement that it cost $40 is concerned. The money that went into that flume went in at the rate of $40 a thousand, and that was the only money. It was the first money rather, that was paid for that work. The Utah Construction Co. was paid for that work at the rate of $60 per thousand, but they furnished money and paid the contractor to put that in. If the district had had the money, they could have made the same contract. Their payment was $40 a thousand. I get that from the Utah Construction
6350 Co.'s books. I went up and asked them just before I made that statement what they sublet that for. The first cash that went in there was $40 a thousand. That obviates all this talk about discount on bonds, which was objected to. I said that that went in at $40 a thousand, and I will produce if necessary to corroborate that, the bookkeeper of the Utah Construction Co., who will bear me out in it. I am not usually a liar in these statements.

Questioned by Master.

It was paid for at $60 in bonds, and it cost $40 in cash. It was sub-contracted and paid for at $40 cash. The Utah Construction Co. which sub-contracted it received from the Irrigation District bonds on the basis of $60 a thousand.

CROSS EXAMINATION BY MR. GREENE.

The flume from the concrete dam to the settling basin on the Stone Dam Aqueduct is on page 9 of the Dockweiler inventory. My
6351 figure on that would be 25 cents for loose earth being the only excavation. My allowance for clearing was $50 an acre; 4/10ths of an acre $20. There is no miscellaneous allowance in the inventory. My segre-

gation is 4/10ths of an acre at $50, $20. 861 cubic yards of earth excavation 25 cents, $215. 33 square yards of grouted rip-rap at 18 cents, $6. 11 6/10ths cubic yards of concrete sills at $10, $1160. That is wrong. That is a numerical mistake. I put it down at $10, and figured it at $100. The lumber is all computed at $45 a thousand, $1350. Tarring, caulking, and hardware are included in that price of $45. The grouted rip-rap item, 33 square yards at 18 cents, $6. 18 cents for grouted rip-rap is not right. 6352

Questioned by Master.

This inventory says the rip-rap is two inches thick. I didn't pay much attention to that. It is one of the small items I have not checked. I see a couple of numerical errors in here. The error is in the concrete. Rip-rap is never laid two inches thick.

Mr. Dockweiler: I am trying to place these items. I would have to get the field notes from which that computation was made. I think I probably put that price in thinking that it was per square foot. Some of the other rip-rap was figured in that way, and I think I have made that mistake, too. There are undoubtedly some numerical errors in there.

Mr. Dillman: The large items I have gone over carefully. The small items make so little difference in the sum total that I paid no attention to them.

Mr. Dockweiler: The rip-rap is two feet thick there, your Honor, and not two inches.

CROSS EXAMINATION BY MR. GREENE. 6353

My items for Structure 26, on page 4, the second section of the Pilarcitos Aqueduct Flume, are 2,426 cubic yards of earth excavation, at 25 cents, $607. 1485 cubic yards loose rock excavation at 50 cents, $743. 60 cubic yards of solid rock excavation at $1, $60. One acre of clearing $50. Lumber at $45, $5,293.

Questioned by Master.

The total there includes Structure 25. On my exhibit, page 1, I have omitted Structure 25, and included the pipe syphon in the flume.

CROSS EXAMINATION BY MR. GREENE. 6354

My charge for framing and erection covers handling the lumber from the point of delivery into the structure, the framing, the placing, the nailing, the transportation and the caulking. The transportation is from the delivery wagon, our truck haul to the work. It covers all of my labor cost from the time the lumber is delivered from the end of the haul until the work is finished. I think there is a point of delivery about from the middle of the first flume to the picnic grounds. If I could not extend the road to the head of the flume, I would try and make delivery from the top of the road to

about where the old house is with the little orchard about halfway down the flume. I don't know how I would get the lumber down to that house. I didn't go up the hill and examine the road, but for that amount of lumber I assumed, and I think my assumption is correct, that at some point it could be lowered there at some expense. There is a road on top of the ridge which I have traveled. At any rate, the delivery should be nearer the actual work than the
6355 picnic grounds. The road is on top of the ridge. I would say about half a mile. It might be a mile by the road you would have to travel; I don't know. There are some steep hills there; the part of it you could see from the canyon looking up. I have seen good skinners handle a full wagon load of lumber down worse roads, worse than what you can see of that road from the house looking up. There is no road from the house up. There is a slope up there. I don't know what portion of the slope you could see. The hillside could undoubtedly be negotiated at some point. I have seen part of the slope, and not all of it, and I don't know what the character of it is. It is a brushy slope. I counted on getting my lumber down that way. If I could not get to the Stone Dam, I would
6356 take it in that way. I would prefer to take it in that way if I could. The map shows the road would be a half mile of distance. You would probably have to go over half a mile to reach it. My appraisal is based on the assumption that I can deliver the lumber to some point along the flume. It might be at either end, or it might be at that house. I think that house has probably been reached by a road over that slope. There is nothing there now to show that. I have an item of $4 a thousand for wagon or truck haul on lumber. I don't know but what I would not chute that lumber over a very steep portion there where it is not steep enough to damage the lumber. That has been done, and I have done it down a slope 300 or 400 feet high. No, not over 200 feet high. It did not damage the lumber, either. I don't know whether I could do it there or not. I would negotiate it in some way, all the details of which I don't
6357 know. You certainly could build a chute. On this particular flume I might lose $5 or $10 a thousand if I had made a mistake in thinking I could negotiate that hill, but I would make it up on some of the other structures. I have not assumed all the details necessary to carry out this work. I have not had time to do that. It would take me years to do it if I had to assume all the details that would be necessary to carry out this work. I couldn't make this estimate at all. If it did not prove practicable to deliver it in the middle of that flume, I might lose money on that particular contract.

The 20% for contractor's profit and contingencies is certainly ample. In an estimate of this kind, where you do not go into all
6358 the details of your plan, and even when you do, you change your plans after you start your work very often. I consider that 20%

is enough. I did not know it was 20%. It sounds a little bit high, but it is not too high. If I have to spend \$5 on it in the extra handling of the lumber, it is hardly high enough. I don't think you are right in taking the average price of lumber for that flume. The average price will be more than \$21. I think it would be nearer \$23 or \$24. If you take the lumber at \$24, that would give you \$6 out of \$45 for contingencies. That is 13%. The allowance of 20%, as to its fairness, depends on how the estimate is made. It is im- 6359
possible to whittle these estimates to a very small point. You cannot tell what your lumber is going to cost until you start to buy it. You cannot tell what your haul is going to be until you have made it yourself, or contracted it to somebody else. You are not sure that this framing is going to cost just \$8, and so, for the purpose of an estimate for taking a contract on the work, or for making a report to the Board of Directors as to the probable cost of work of this kind, this estimate will whittle down sufficiently fine.

I assumed for haul from Millbrae to the Stone Dam Flume an 6360
average of \$4, I think. I don't know how long the haul is. I have never measured it. I assumed an average haul of 8 miles. I assumed that my lumber would weigh two tons to the thousand, and that it would be hauled at 25 cents a thousand, including the loading and unloading. That makes the average haul 8 miles. This would be about the furthest flume; I think it is about 10 miles. I take Mr. Lawrence's estimate for that, whatever it is. If Mr. Lawrence's figure is 8.95 miles, my average of 8 miles is sufficiently high. I think I could haul from Millbrae to either the picnic grounds, the dam, or to the cottage, for 25 cents a ton mile, including loading and unloading. That is based on my general knowledge of the cost of hauling. The specific bit of information is this: I have hauling done in Shasta County, across the Sierra Nevada Range, a distance of 60 miles, in any lots that I care to furnish freight in, and that includes loading and unloading, which, of course, in the case of a 60 miles haul is a small portion. That costs me a cent a pound, or 6361
33 cents a ton mile in less than loads. The freighters are rather anxious to get the hauling. When I have a carload of salt, or anything of that sort, I put my own teams on the road and do my own hauling in preference to paying that amount. If I could furnish full loads and steady hauling, I could probably get that done for about ¾ cents a ton mile. This has been going on for a good many years. The roads that my man hauls over are a great deal worse than the roads between Millbrae and this country. That is from Redding, a distance of 60 miles and was by four or six animal teams. There are sometimes one wagon, and sometimes two, depending on whether it was bulk freight or heavy freight. I think they intend to load about 1,000 pounds to the animal. They go from 500 to 600 feet at Redding to 4,700 feet. They make the round trip

in about five days. They get about $60 for a round trip. According to that they would get $12 a day. They may haul with four ani-
6362 mals; in that case they would get $8 a day. They do not haul their feed. They get better feed in the hills than they have at Redding. They get grain in the hills at the Burney end from the Fall River Valley, it is grown and threshed there. I don't think it has ever cost three cents a pound. They make these trips sometimes with very little grain. They don't keep their stock fed full all the time. They sometimes travel short days on the down trip. I doubt if they feed much grain. I don't think if they fed much grain they would go bankrupt on my prices. They have kept at it for a good many years. $12 a day is a pretty good price for a six-horse team.

I have not allowed any waste in my lumber. I assume the waste is taken care of in the inventory. I think my information is to that
6363 effect. If it is not shown in the inventory, my estimate is short in that amount. I have not gone into the detail of how much I could carry on my motor trucks in hauling to the Spring Valley flumes. I would carry what I could. It would depend on the size of the motor trucks more than anything else. I have not assumed a five-ton truck, or anything of that kind. The lumber will be partly seasoned. There is no necessity of complete seasoning of lumber that goes into the flume. I don't think the lumber that went into these flumes was completely seasoned. I see no necessity for it. As a matter of fact, if it was completely seasoned, and the flume was built tight, when the water was put in it would burst something. It is very different from house lumber, which has to be seasoned and painted. I have not let the lumber season a year, and if it developed that the lumber which went into the flume was actually fully seasoned lumber I have not in my estimate reproduced the actual identical structure. It would not be bad construction to build a flume with seasoned lumber. You would have to be very careful about tightening it up. You would have to give it a chance to swell or you would have some trouble. I have not assumed the lumber
6364 would be delivered at ship's tackle, or anything of that sort. The difference between delivery at ship's tackle and some other way is much less than the difference which a shrewd buyer would make against an ordinary purchasing agent. I think the lumber would be bought at the mill and delivered at ship's tackle down here. I think it would undoubtedly be bought of one of the big milling firms, either of Hooper, or Hammond, or Tyson, or some of these other big fellows. I don't know what the custom is as to standing breakage. Breakage would not amount to very much anyway. It ought not to if it was properly handled. There is always a right of rejection on account of breakage in transit. I presume in this case you would make the lumber company responsible for the delivery of the car at San Mateo or Millbrae, or Brightside, or wherever the

lumber was delivered. The matter of cargo rates is something that I have not gone into. I have assumed no breakage. I have not assumed any rejection at construction unless it was broken by the handling of my own crew. I have assumed no such breakage unless it is taken care of in the accidents and incidents to decrease the profits. There would be a small amount of breakage. I have not 6365
made any allowance for it.

On such a flume as from the Stone Dam to Tunnel No. 1 I would have a foreman, two carpenters, and enough helpers to keep the carpenters going. Principal cost in framing and erection is handling lumber by hand. The actual cost of fitting, storing and placing the lumber is not very great. The bulk of that $8 would be in handling the lumber. I should handle it with hand trucks as a general rule for most of the distance, but just at the end it would have to be carried. The hand trucks would either go on top of the flume or on the bottom of the flume. I would rather think in that case that the sills and one post would be put in place, and about three or four planks laid next to the post, and top of them there would be placed the top planking to stand the wear of trucking, and then I would truck right down the flume and have the outside of the flume open. I have done that in my experience. I would use the top planking of the flume for the trucks to go over. I would lay it to preserve the bottom planking, and then I would use it as top planking afterwards. It would not be quite as good after using it for 6366
this purpose. It would be somewhat worn, but it would be sufficient for the purpose. The top planking is pretty poor stuff, anyway. In regard to the Spring Valley flumes, I assumed that the top planking was pretty poor stuff. I did not know what the history was.

Questioned by Master.

Mr. Lawrence: The top planking of the Spring Valley flumes was known as No. 2 quality of $1\frac{1}{4}$ inch redwood. Now they call it "mill run". They have changed the classification. In the inventory it is classed as rough redwood. It is not the same quality as the sides and bottom.

Mr. Dillman: The sides and bottom are very fine quality. Most of it is first-class, clear lumber.

CROSS EXAMINATION BY MR. GREENE.

I would not have my crew specialize on different lines of work, 6367
as for instance, a carpenter for laying intersecting sills, and a carpenter for laying intermediate sills, etc. I have not any figures on what my payroll per day would be. I could make a lay-out for you and assume those things. I think of this more in board feet per day than in the unit of actual cost per day. A big crew would lay more flume. I would put on all the men I could handle on the work. You

could get too many men, and they would be in one another's way. I would have my framing done at the lumber yard, and all the gains. That is all you could do there. All the sawing there is to do is simply to saw the planks to fit the sills. The sills are placed ahead of the planking. I would have a working foreman, and he and one carpenter on the work placing sills, with helpers to handle the lumber, and then sawing and placing the planking. They would do a great deal of that work. I have placed that kind of work at the rate of 1,000 feet to the man. I don't think it can be done here. In this case man-handling the lumber is much more than it would be there. I would expect to get 500 feet to the man. I have never found that there was any advantage in making my gains in the
6368 yard instead of making them on the job. I don't find any disadvantage in that your fit is not entirely accurate if the work is done on the job itself. I would not get a leaky flume if it didn't have a notch. Aside from that, my lumber would be cut on the work. The posts would be sawed before they started down the flume too and afterwards the caps. Of course you would have to back in your caps. You would have to put your caps in at the lower end if you put your runway in on the flume.

I think the company's figure for hardware is nearer right than mine, but $1 is the customary figure that I have been using in estimates of that kind for a long time. I would not give weight to their records in that particular. I have not changed it. I would not have the same feeling as to other items of cost as to which they have exact records. It would not change my opinion at all as to what they did. If you care to have me do so, I will give you a little history of work I did in Kern County, not building a flume, but in doing work of a similar nature so far as cost went, the matter
6369 of bridging in 1894 and 1895, which may clear up some of these points which you seem to think important, but which I do not.

The average haul on the Oakdale job was 12 miles. I assumed that the avearge haul for the water company's flumes was 8 miles. The difference in cost on account of that haul of $3 sounds a little bit high to me now. Except to say that it sounds a little bit high, I don't know that it is. I will let it go. As far as the roads are concerned, the haul is not any more difficult at Oakdale than it is on an average on the Spring Valley roads. They both have to go off the main roads a little bit. I think the Spring Valley roads are a little easier in gradient on the average. I don't know the hauling cost at Oakdale. I assumed that it was $7. The charge of $7 includes handling and re-handling, loading and unloading. I don't know what the charge was there. I think the work was contracted to an independent hauling concern. I think I can ascertain that. I am not sure if the Utah Construction Co. have the records. If that
6369½ hauling was by a sub-contractor, I don't know that I can.

For the same amount, flume excavation would be cheaper than
ordinary railroad work, but because it is in a small amount it would
not be cheaper. They use the same methods somewhat on railroad
contracting. The gross amount of railroad work of that character 6370
would not be done by steam shovel. They never put a steam shovel
on that light excavation. It would have to be heavier than this
road excavation ordinarily to put a steam shovel on. I didn't depend on Western Pacific figures. I think the Western Pacific figures
through the Niles Canyon were 18 cents for earth. That included
work in considerable quantities when it should be done cheaper.
Also it included a sewer, which is not present with this work. To
a certain extent they would offset each other. Twenty-five cents
would very easily do this road excavation, because it is simply picking and throwing over the bank. The clearing, I think, is taken
care of in a separate item. The clearing itself on some of these little
side flumes is probably more than the excavation. If I could let this 6371
work to men that I know, I could let it for 15 cents. Twenty-five
cents is plenty to do that earth work.

The $30 referred to on page 6170 of my testimony, which I allowed for extra lumber, was for lumber that was piled along the flume at the end of the flumes for repairs. I think that is what I intended it for.

RE-DIRECT EXAMINATION BY MR. SEARLS.

In 1891 or 1892 the Port of Portland Commission received bids
for a lot of bridging. This included pile-driving and planking some
of the nailing for which had to be done under water. I bid on
that work $11 per thousand for lumber furnished, transported,
framed, erected and fastened. That furnished everything. I was
not the low bidder, and I lost the work. I went to Kern County
in California, and in 1894 or 1895 bid on some county work. That
was the only money being spent in the state at that time so far as
I could find out. I had to get down to bedrock to get the work. I
went there and I was the low bidder by several dollars a thousand.
The lumber people had combined, as they usually do, and stipulated
that the lumber must cost so much. I didn't go to them at all until
after the contract was let. When the bids were received they came
to me, but I did not talk with them. When the contract was let
and signed, I then saw them. It was explained that Dillman would 6372
go broke on the job, and could not possibly do the work; could not
possibly haul the lumber for that price. I put in those bridges, including the pile-driving. First I bought the lumber. I said to the
dealers, I know what your lumber costs. I would rather give you a
little something than to buy on the outside. I can buy lumber as
cheap as you can. I will give you what I know your cost is, plus
$2 a thousand to handle this locally for me. It cut their price that

they had given to every other contractor on the job from $8 to $10 a thousand, but it allowed me to get the work, and I needed it. I hauled, framed and erected that work, and framing, erecting, including pile-driving was less than $6 a thousand, the actual cost to me, and while I didn't make a very large profit on the job, I made a good living for a couple of years.

Questioned by Mr. Greene.

That was bridge lumber. That work, for which I allowed $6 a thousand, is comparable to this work here for which I allowed $8 for framing and erecting.

EIGHTY-EIGHTH HEARING. JANUARY 31, 1916.

Witnesses: F. P. Muhlner for Plaintiff.
John M. Bailhache for Defendants.

6373-6374 (Certain corrections noted in the transcript.)

6374 DIRECT EXAMINATION BY MR. GREENE.

Muhlner I am 31 years of age, and am the assistant auditor of the Spring Valley Water Co., having held that position since 1908. I came with the company in 1906. I graduated from high school in 1902 and went to work in the wholesale department of Goldberg, Bowen & Co. in 1903. My duties with the water company have been varied. I was employed as clerk in the Secretary's office, where the accounting was done at that time; later, when the work in that office was split up, I became the assistant auditor under Mr. Gower, in 1908, and since that time I have held that position, and been in direct charge of the accounting of the company. I have been in direct touch with the company's accounts since August, 1906, to date.

6375 I have prepared tables showing the income and operating expenses, and taxes actually accruing and paid out during the fiscal years of 1907-8 up to and including 1914-15.

Introduced and marked "Plaintiff's Exhibit 124."

These tables which are contained in "Exhibit 124" represent my own work as to the original figures, though I had clerical assistance in some cases. The statement of bonded indebtedness, Decem-
6376 ber 31, 1913, is a copy of a memorandum that was furnished to Mr. Long, City Attorney. It was prepared for him to show the financial indebtedness of the company, and also to show the disposition of the general mortgage bonds, and the 5½% collateral trust notes at that time.

(The two sheets covering the above memorandum were marked 1 and 1-a.)

Referring to sheet entitled "Dividends", (Marked No. 2): This sheet 2 represents the accrued dividends from 1902 down to June 30, 1915. In other words, these represent the actual charges brought upon the books for the dividends accruing in that period, whereas, the paid dividends would represent the cash payments on account of dividends.

Questioned by Master.

There is a difference between the two in this, that during the period from 1902 down to June 30, 1915, there might be some dividends due, and not actually paid out. The payment might occur in 6377
the following fiscal year; for instance, a dividend might be declared on the 31st day of a month, or at the end of a year, which might not be paid until a succeeding period. The dividends paid, according to this statement, will be shown in "Exhibit 12-bb".

DIRECT EXAMINATION BY MR. GREENE.

Referring to the next sheet, marked 3-a and 3-b: This statement shows by months the amount of the 15% money that has been impounded by order of the Court from 1908 to July 31, 1915, with the amount of interest that has accrued in each suit down to that date. The fifth column represents the total amount of interest at that particular time accrued on those particular suits. This statement does not show the amount which has accrued in each suit from the time the moneys were impounded up to the first of this year.

Questioned by Master. 6378

Refer to suit No. 96; the total of the interest column, $41,996.91, represents the amount of interest that had been credited to the departments in the bank between August 28, 1914, and July 22, 1915. The interest does not really represent the amount of accrued interest down to this date of testimony as to each suit, but it does represent it to July 22, 1915.

Questioned by Mr. Greene.

The $41,996.91 does not represent the interest which has accrued in suit 96 alone; this is the amount of interest that has accrued in all the suits during the particular period from August 28, 1914, to July 22, 1915.

Referring to the item "Less the following sums paid out by 6379
order of the Federal Court," on the bottom of page B: The first item is the taxes on the deposited money for the fiscal year 1913-14, $31,572. The next item is the tax for 1914-15, amounting to $40,556, also fees paid on March 27, 1915, to the Special Master in Chancery, $250 for each suit, making a total deduction from the deposited moneys of $73,879. The last column shows the net amount on deposit in all the suits at that time, July 31, 1915, or $2,253,000.

Mr. Greene: I should assume that each suit would stand on its

own feet, and if there were any accrual, it would go to the people who are protected under the injunction. As a matter of fact, the fund is being depleted now, because the taxes are in excess of the interest.

(His Honor's attention was here called to the fact that there is no money impounded in suit No. 14,735, which is one of the cases
6380 on trial, but it was explained by Counsel for Plaintiff that the order in that matter was for a bond to be given, and the company to collect without any restriction as to amount.)

DIRECT EXAMINATION BY MR. GREENE.

Referring to the next table, marked 4: This table shows the revenue from water sales for the fiscal years 1907-8 down to 1914-15, inclusive, divided into the various departments, flat rates, meter rates, shipping, building, City and County, and the total. It shows, also, the amount of the 15% increase.

Questioned by Mr. Searls.

This is revenue, and not receipts. Revenue represents the amount of actual charges for water sales during the particular period, while receipts would be the actual collections which might embrace that period, or a portion of it, and another period, for instance, a prior period; January collections might include some of the preceding December business.

Questioned by Mr. Greene.

Revenue would show indebtedness which existed during that
6381 period, but which was not necessarily paid. It is very difficult to account for bad debts at the time when the debt is incurred. Bad debts are usually taken into account in the accounts when they are written off at some subsequent time when we find we are unable to collect them, however, they are not included in the table which I have here.

DIRECT EXAMINATION BY MR. GREENE.

Referring to the next table, marked 5, headed "Operating expenses, excluding taxes, depreciation allowance, interest, dividends and reserves for the fiscal years 1907-8 to 1914-15": This table represents in detail the operating expenses for the fiscal years 1907-8 to 1914-15, inclusive, and also the detail of the average of the past three fiscal years. That is shown in the last column. In the column after the numbers are shown the headings of the general operating accounts, and there are further classifications of those accounts which are sub-classifications of the main accounts. The column four lines from the bottom of the page, entitled "Taxes accrued" indicates the actual taxes accrued during the fiscal period as noted at the head of the column; that represents city and county taxes, and state franchise tax, etc.

Questioned by Mr. Searls.

I have not included any taxes on impounded money in this instance. 6382

DIRECT EXAMINATION BY MR. GREENE.

The figure of $260,000 in the last column, "Depreciation and obsolescence," is the amount the company has been providing in its accounts since 1908 for depreciation and obsolescence allowance. It is included here for 1907-08, although not charged until 1908, in order to make the lower figures comparable.

Questioned by Master.

The company does not take $260,000 each year and buy bonds, but it has been making reinvestments in its own plant in the line of real estate and physical structures that far more than offset this figure.

DIRECT EXAMINATION BY MR. GREENE.

The footing of each column represents the sum of the operating expenses as shown there in accrued taxes and allowance for depreciation.

Referring to the next sheet marked No. 6, headed "Recapitulation of taxes, fiscal year 1907-08": This sheet, together with four or five others following, represents the recapitulation of taxes for the various fiscal years, each year being on a separate sheet. This particular sheet, No. 6, represents the taxes for the fiscal year 1907-08, divided into the various counties in which the company 6383 owns property, and also divided into the amount of personal, realty and improvement assessments, and the amount in money of those taxes. The $2,500,000, in another column, is the amount of the franchise assessment in the City and County of San Francisco during that particular period, and the $3,000,000 is the amount of riparian rights assessment in Alameda County.

(It was conceded by Counsel for Plaintiff that the $2,500,000 was the San Francisco Assessor's assessment on all the water company's properties, including general corporate franchise.)

Questioned by Master.

Referring to the column "Additions and deductions"; during that particular year, the Stockton Street property was sold. The company was paying taxes on that property on account of the mortgage; we were reimbursed for the amount of those taxes. That deduction of $6,000 represents practically all of the taxes on the 6384 Stockton Street property.

Questioned by Mr. Greene.

The last column represents the amount of taxes actually accrued during that year, and after making deductions which seem to me suitable.

DIRECT EXAMINATION BY MR. GREENE.

The next sheet, marked 7, shows the same facts with regard to the fiscal year 1908-09. There were deductions, but the amount has been taken off for the amount of the assessments, and also for the amount of the taxes; it was deducted before the entry was made here. In the next sheet, marked 8, fiscal year 1909-10, there is one addition, namely, the federal taxes for 1909, which do not appear in the preceding statement. The next sheet, marked 9, shows the same facts in regard to the fiscal year 1910-11. The next sheet, marked 10, shows the same facts with regard to the fiscal year 1911-12, with the exception of the franchise tax in San Francisco County, and also with regard to the state franchise tax.

Questioned by Mr. Searls.

6385 This conclusion, that the Assessor of San Francisco has increased the assessment on improvements, was based, according to my recollection, on an admission by Dr. Dodge at that particular time. The $2,500,000 is not shown on the assessment books for this particular period. We were paying on our improvements, pipes, meters, and underground construction—on a certain assessment, and the following year it was increased by approximately $2,500,000; I believe it was admitted afterwards, by Dr. Dodge, to be a fact, but I am not absolutely sure of it.

If you will notice on sheet No. 10, the amount of personal property is $977,000; a considerable portion of that was afterward changed to the heading of improvements, if my recollection serves me correctly. It only appears as $83,000 on the next page.

Questioned by Master.

6386 The $2,500,000 does not appear on the last page, 1914-15. We have tax bills for that year, but I think subsequently to 1910 the tax bills do not show the $2,500,000 franchise. I don't quite recall the year when the change was made by the Assessor on the rules, but it was somewhere about 1910. Subsequently to that it appears as pipes, meters, and underground construction, at approximately $6,000,000. We have here made a segregation to show for the purposes of uniformity throughout these statements, with the exception of the last statement, that there is a franchise assessment.

Questioned by Mr. Searls.

The Assessor raised our assessment about $2,500,000 on one particular item.

6387 Mr. Greene: Of course, in the early years there was a distinct assessment on franchise. After the assessment was all made as a unit, Mr. Searls, you object to Mr. Muhlner's segregation of that total again; that is your position, isn't it?

Mr. Searls: Yes, exactly.

Questioned by Mr. Greene.

Mr. Muhlner: I think I made that segregation for 1911-12, but I do not recall the particular year when that change was made.

(The witness was requested by the Master to bring in the tax 6387-6389 bills from the years beginning 1910-11 and the years that follow, for San Francisco County, and it is understood that the ones that are wanted are the ones that show the personal property tax, and franchise.)

DIRECT EXAMINATION BY MR. GREENE. 6389

Sheet marked 11, fiscal year 1912-13: The municipal license, which was carried under the head of a general expense, was brought in this year as a tax. That is the last item, amounting to $1,004. The quarterly license is $251, which we pay the City and County of San Francisco to operate a business.

Questioned by Master.

It did not begin as an instituted tax in 1912-13; we have always paid it, but it has been charged to general expense. The state license that year was $32,180. The next item also is new; that is the license tax for that particular year on corporations—a corporate license tax. That also was formerly carried under general expense. When the Railroad Commission authorized a new accounting for water companies and other public service corporations, they included all those taxes under taxes, and not under general expense, as we formerly carried it.

Questioned by Master. 6390

They did not include automobile licenses. Those are charged directly against the particular machine, and are later segregated into the account that the machine is used for.

DIRECT EXAMINATION BY MR. GREENE.

The next sheet, marked 12, fiscal year 1913-14; referring to the statement in that sheet, ''federal tax—billed by Internal Revenue, but not yet paid, calendar 1913''; at the time this statement was made up, the wording should have been changed, because my recollection is that that tax was actually paid during that time. This statement was made up prior to June 30, 1913. The bill we received had not as yet been paid, as we pay those taxes to the Federal Government in June of each year. This tax was, in fact, paid subsequently, and the wording should have been changed.

(By consent of Counsel for Defendants and the Master, the words ''but not yet paid'' were stricken out.)

The next sheet, marked No. 13, shows similar facts with regard to the year 1914-15. I have a reference to tax on impounded money at the bottom of this page, but simply as a memorandum. That is not included in the total taxes for that year. That was charged

6391 directly against the fund, and not against our taxes account. With reference to the third column, the fourth figure from the top, $2,593,-536; prior to this year Alameda County assessed in the two districts of Pleasanton and Washington Townships $1,500,000 as a separate assessment for riparian rights; this year, 1914-15, they made a change, and increased the value of the real estate in Pleasanton Township by $1,500,000, and separately assessed the riparian rights in Washington Township $1,500,000.

Questioned by Master.

In prior years it was riparian rights $1,500,000 in each of those townships, making $3,000,000 in all.

DIRECT EXAMINATION BY MR. GREENE.

The last table, marked No. 14: This shows in detail the revenue and expenditure for the fiscal years 1907-08 and 1914-15, inclusive, of the revenue of the company for water sold, for various other items of income and revenue, and also the operating expenses, taxes,
6392 and the allowances for depreciation. The first item, water sales, including 15% under injunction, is the revenue as to charges only in the City and County of San Francisco. Item No. 2, marked ''Suburban Company,'' is for water sold outside of the County and City of San Francisco.

Questioned by Master.

The Suburban Company does not actually handle that; it is simply the title of an account which we have carried on since 1906.

DIRECT EXAMINATION BY MR. GREENE.

''Rents'', opposite item No. 3: Those are the rents the company received for property it owned during those particular fiscal years; Item No. 3 represents the cash received in rent, and to that extent, differs from water sold.

Questioned by Master.

6393 This item of rents is for rents from tenants of agricultural lands.

''Turn-ons''; you will find them for the two fiscal years 1909-10 and 1910-11, and they represent the fee paid to the company where it has been necessary to send a man out to re-turn-on the water where the consumer has not paid his water bill, and it was necessary to shut the water off. That practice did not prevail only in those two years, for to a small extent we still charge, or did charge, up to June 30, 1915, but the fee is credited to operating account. Instead of showing here as a revenue under miscellaneous, it will show as a deduction against the operating expenses. To explain why we have no item of service connections for 1913-14, you will notice, item 15, that the expenses that year were in excess of the revenue. Item 12 represents the cost of presenting the company's case in Washington in that particular fiscal year, 1908-09, and has no reference to the water rate suit.

(Counsel for Plaintiff stated that he believed that it could be conceded that that was with reference to the City's endeavor to get the Hetch Hetchy permit.)

"Accrued taxes" represents similar totals in the previous sheets, 6394
but one or two years do not compare; the year 1912-13, the year 1913-14, and 1914-15.

Questioned by Mr. Greene.

The difference lies in the provisions in the accounts for the estimated amount of the Federal Income Tax. When the statements are made up at the end of the year, we do not know exactly what that Federal Income Tax will be, and it is necessary to estimate it; we do not know until the following March or June just how much that will be. We don't know what the net income of the company will be prior to making up the provision in the account for the amount. These are the actual amounts accrued. Should we make any mistake in the amount we charged in for taxes in one fiscal year over another, we correct that the next fiscal period.

The figure $481,000 in the year 1913-14 represents the amount 6395
of the accrued taxes as compiled from the tax bills from the counties and the state, and the estimated amount of the Federal Income Tax for that period.

Questioned by Master.

The Federal Income Tax covers a calendar period, and not a fiscal period. The last page represents the amount accrued. We estimate what the amount will be, and we correct it in the following period if we happen to be too much or too little. There would be a difference, because in the fiscal year 1913-14 the Federal Tax that we paid would be for the year 1913, but there would be six months of the year 1914 which we are estimating.

Questioned by Mr. Greene.

In order to make the figures for taxes comparable, one year with another, it is necessary to estimate it; for that reason, the taxes as shown on this large statement would be more nearly correct for figures for comparative purposes than the taxes on the other statement. If I remember correctly, I based my estimate of those taxes on the amount of the taxes for the preceding year, allowing a reasonable amount for increase in the business; that tax is based upon net 6396
income.

(It was here suggested by the Master that it seemed to him that 6397
all it was necessary to look at was the actual amount of taxes paid for the period 1912-13, and not the amount accrued, or the amount estimated to be paid in the following 6 months, but the actual check that passed, regardless of the period which it covered. The matter was passed for the present with the idea that some correction of it will be made that will be as accurate as can be gotten at.)

Witness: JOHN M. BAILHACHE for Defendants.

6398 DIRECT EXAMINATION BY MR. SEARLS.

I am 55 years of age, and am examining accountant for the City Attorney of San Francisco. I have been an accountant about 17 years, actively. I was employed by the United States Government in 1898 to audit and prepare the accounts in the general supply depot of the army, in New York City. These accounts were for general purchases for the army—for Cuba and Porto Rico, and later on for the Philippines. I occupied this position for about 2 years, and then at my own request was transferred to San Francisco, where I was placed in charge of the funds and accounts for the Chief Quartermaster's
6399 Office of the army. The Quartermaster's Department is the business department of the army. We had charge of the supplies and funds pertaining to all the army posts in this department and Hawaii and also the recruiting stations and the government steamers. It involved a great deal of detail; monthly statements and settlements with the Quartermaster General's Department at Washington, D. C., and also balancing with the United States Sub-treasury here, all of which went on for about 10 years. At the end of that time I resigned. In 1911 I was engaged as engineer accountant by J. H. Dockweiler, and while in his office I worked on a number of rate and valuation reports, the principal ones being the Contra Costa Water Co. vs. the City of Oakland, a report made for the Modesto-Turlock Irrigation District, the American-Consumnes Water Supply, and the East Bay report—being a report on the water supply for the East Bay cities; the last three were for the City Attorney of San Francisco. The East Bay report was used in the Hetch Hetchy matters in Washington, as was also the Modesto-Turlock report, and I think the other was too. I was also engaged on the valuation report of the Crocker-Hoffman Land & Water Co., and the East Side Canal Co., both of which were controversies before the State Railroad Commission. I assisted engineers William Mulholland, and Luther Wagoner, in making their valuations and reports in regard to the Contra Costa Water Co. I also checked and analyzed the figures of the engineers on the other side, Messrs. Sterns, Hawgood, Adams, and Cattall. Since 1913 I have been in the employ of the City Attorney of San Francisco, as examining accountant, and during that time I have had to examine the books of practically all of the public utility corporations of this city,
6400 and as a result of these investigations I became familiar with the accounting systems used in these various corporations. I am familiar with the system of public utility accounting prescribed by the State Railroad Commission of this state. At the request of the City Attorney's office, I made an examination of the income and operation account of the Spring Valley Water Co. for the years involved in the litigation here.

(Certain books were introduced in evidence by Counsel for Defendants, with a request that they be marked respectively No. 125, A125, B125, C125, D125, E125, F125, G125, H125, I-125.)

Mr. Bailhache: The volume marked "125" contains a summary of the details included in the other volumes, for the different years. I have attempted to show by this exhibit the net operating revenue, without any attention at all to depreciation.

Mr. Muhlner questioned by Master.

Mr. Muhlner: There is not much difference between revenue and 6401
income; they are practically synonymous. Revenue embraces a few more items than income. Income might be applied entirely to the particular activity of your business—your income from water, your income from water sales; your revenue might embrace your water sales, as well as your rents and other items. I have included my rents under miscellaneous revenue. By receipts I do not mean the same thing as Mr. Bailhache means by revenue receipts.

The Railroad Commission provides that a company shall keep its accounts according to certain forms. They prescribe revenue as that which you are lawfully entitled to for your services. We construe that, and I think most accountants do, and the big public service corporations do, to be the charges for your income—for your revenue, for the particular period that you are accounting for as distinguished from receipts; receipts may embrace more than one fiscal period. My term "revenue", and Mr. Bailhache's column "revenue charged on the books", ought to be the same. 6402

Questioned by Mr. Greene.

Mr. Bailhache: The $30,724 covers water furnished during the period preceding 1907-08, and it simply shows that the collections were slow in that year, and they got that in the next year.

DIRECT EXAMINATION BY MR. SEARLS. 6403

Mr. Bailhache: Volume A125 shows the receipts, operating expenses and taxes for the fiscal year 1907-08, and the exceptions which I have made to operating expenses during that year. The first page shows the statement of revenue receipts, operating expenses and taxes, showing the deductions from the operating expenses charged by the Spring Valley Company, and the net operating expenses, adding in the taxes, making the total deductions and the net receipts, without any consideration of depreciation at all. On pages from 2 to 7, inclusive, is shown the Spring Valley's operating expenses, as reported by them to the Supervisors. The first column shows the statement made to the Supervisors, and the second column shows a difference between the statement to the Supervisors, and the Spring Valley Books of that year, of about $10,000. I have used the last statement in making up my summary, namely, the one I found in the accounts. The total is $628,831.74. The third column shows the de-

ductions from operating expenses that are considered as permanent
6404 improvement charges, that is, capital charges. Those deductions were made by me, and in making up these tables, I acted under general instructions from the City Attorney, followed by special instructions from Engineers Moody and Ellis. The fourth column shows items eliminated from operating expenses as being considered not a proper charge, and the fifth column shows the net operating as found.

Going down the page, each of the names, City Pumps, Black Point Pumps, and so on, refer to accounts as carried in the Spring Valley Company's books. Referring to page 8; it shows the total operating charges from July to December, 1907, for the City Pumps.
6405 There were no deductions made in that. On the same page are shown the same charges from January to June, $15,739.03, less an exception to lamps and tape, shown on voucher 4284, amounting to $11.95. That exception I have put under a column I have entitled ''Capital Account'', and the idea in making the exception was that that is considered a charge to permanent improvements, being something that was used in construction work.

Refer to page 40; account headed ''operating account, Lobos Creek''; I have eliminated the entire amount of the operating expenses for those years, and which are carried under the heading ''eliminated'', the idea there being that the Lobos Creek items were not used or useful, which information was given me by the engineer in charge.

Questioned by Mr. Greene.

As to whether an item should be included or excluded, it depended on the nature of the item whether I exercised my own judgment, or was directed by someone else; if it was an engineering item, I consulted the engineers. In this instance of Lobos Creek, I
6406 was instructed to throw it out. In the case where I threw out lamps and tape; that was not based on my own judgment as to whether that was a construction or operating account; I had instructions which guided me with regard to those things.

Questioned by Master.

I threw the lamps and tape into ''capital account'' because I was told to put all permanent tools, anything that would last more than a year, into that charge; anything that would be used up in a year, would be called operating expense.

Mr. Searls: Our instructions to this witness were to use his judgment as to including items under these general headings. For instance, if he could tell from the voucher whether the item in question were being used in certain permanent work or not, there was no particular instruction that would cover that class of items except the instructions to throw into the ''capital account'' all items which were on their face permanent improvement charges. That could only be determined by an investigation of each voucher, and he did exercise

his own judgment where it came to the inclusion of items of that sort.

Questioned by Mr. Greene.

Mr. Bailhache: My general instructions were to exclude all tools 6407
of a permanent character, and matters of that sort, that would go into construction account; also to consult with them at any time when anything came up that I was in doubt about.

Questioned by Master.

I put into capital account any tool or appliance which would last a year or more, and shovels, and picks, and things of that sort, small tools that get lost, or things that would wear out, would be put into operating expenses, and allowed to remain there; larger tools, and things of a permanent character, we considered in relation to capital account—that is, tools and materials.

Page 53, general expense account, column headed "special"; the specials are not deducted; they are simply items noted, to be considered later. They were put down there to be taken into account if it 6408
were considered proper to do so. It is mostly for furnishing supplies at the Spring Valley cottage at Sunol, and the Crystal Springs Dam.

(Counsel for Defendants stated that he did not think the City would claim any deduction under the heading of "special".)

Referring to column entitled "eliminated"; there is an item under voucher 2356 for $25 for a floral design, which I did not consider an operating expense, so I deducted it. In February there was a donation of $50 for the Policemens Ball; that was taken out. Further on down are some advertisements, which I think were advertisements advising people to vote against Hetch-Hetchy bond issue, or something like that—I can't exactly remember now.

The voucher will show what the company's letter to the Supervisors was that is referred to in this item.

DIRECT EXAMINATION BY MR. SEARLS.

Page 60: After these first pages were made up, I obtained some information in regard to general salary account, which I was unable to get before. This shows certain deductions from salary accounts 6409
covering the same period that the book does, and the summary of that is included in the book marked "Volume I-125", which shows the method of arriving at these deductions, and why it is done. That was done by me.

Questioned by Master.

The total deductions on page 60 are $11,126.88; the total of the original charge there, as shown in the front, will be found on page 52 of this exhibit, showing that the total amount of general salaries was $38,499, as shown here; that is segregated into three divisions to show the salaries that were paid to the president, vice president

and the secretary, and their assistants, to the auditor, the assistant auditor, the assistant secretary, and their assistants, and the chief clerk which they had at that time, and his assistant.

6411 Questioned by Mr. Greene.

Volume B-125, page 44, statement headed "except 15% from water sales": That is 15% from the water sales department, which is charged in the shipping department. There are a number of deductions under the water sales department. The water sales department is divided up and segregated to the shipping department, the inspector's department, the collector's department, the bookkeeping department, and the contractors and builders department, and that is the proportion that applies to the shipping department. The item $403.75 is the portion of capital account on page 43 preceding it, and is apportioned to capital, because I put it all in capital on page 43. I have certain figures here covering expenditures during January,
6412 February, March, etc., but I do not take 15% of that. I take 15% of the amounts appearing on page 43.

Questioned by Mr. Searls.

It is charged to capital account because in the water sales department the total deductions are charged to capital account, and then afterwards the total of the water sales department is split up amongst those five different departments, shipping, inspectors, collectors, bookkeeping, and contractors and builders. In deducting this 15% on page 44, I have not duplicated a deduction from page 43. You will find that same thing in the inspectors department—water sales department 25%. That is made necessary by the way the Spring Valley segregated their water sales department against those different divisions.

Questioned by Mr. Greene.

The percentages shown there are the percentages that Spring Valley uses in segregating the water sales department expense.

EIGHTY-NINTH HEARING. FEBRUARY 2, 1916.

Witness: Drenzy A. Jones for Defendants.

6413 Counsel for Plaintiff—Mr. McCutchen—stated the following with reference to a sale by W. S. Hobart to C. W. Clark, of some land near San Mateo, which facts he got from the Secretary of the Hobart Estate Company, and which facts Mr. Searls, Counsel for Defendants, is willing to admit that witnesses familiar with the facts will testify to if called. In April, 1913, an agreement was made by Hobart and Clark, by which Hobart agreed to sell, and Clark agreed to buy 270.22 acres of land, being the land referred to, at $750 per acre,

or a total of $202,665. Contemporaneously with the making of the agreement, Clark made a payment of $10,000 in cash. At that 6414
time the property was subject to a mortgage to the Union Trust Co. for $35,000, and Clark, by an agreement with the Union Trust Co., assumed the payment of that mortgage, not as a part of the purchase price in addition to the sum mentioned, but as a part of the $202,665. At the same Clark gave Hobart a promissory note for $157,665, bearing interest at 5 or 6%. The note and the deed were delivered to the Union Trust Co. as escrow holder, the deed to be delivered upon payment of the note, and since that time Mr. Clark has promptly paid the interest on the note.

These facts were stated by Counsel on information given to him by the Secretary of the Hobart Estate Co. and Counsel is willing to vouch for the truthfulnesss for the statement. Counsel for Defendants stated that that was satisfactory.

Counsel for Defendants here stated that he desired to offer 6415
certain matter in rebuttal to the proposition of the purchases of the Hetch-Hetchy Reservoir site, which were relied upon both by Mr. Grunsky and Mr. Corey in their testimony, and preliminary thereto he read the following from the Garfield Permit, page 413, as issued by the Secretary of the Interior of the United States, on May 11, 1908, and as reported in Volume 36 of Land Decisions, page 409 et seq:

"The City of San Francisco, through its regularly authorized "representatives, has, in order to protect the interests most directly "involved, agreed to file with the Secretary of the Interior a stipu-"lation approved by specific resolution of the Board of Supervisors, "and duly executed under the seal of the City of San Francisco, "as follows:

"1. The City of San Francisco practically owns all of the "patented land in the floor of the Hetch-Hetchy reservoir site, and "sufficient adjacent areas in the Yosemite National Park, and the "Sierra National Forest to equal the remainder of that reservoir "area. The City will surrender to the United States equivalent areas "outside of the reservoir sites, and within the National Park, and "adjacent reserves, in exchange for the remaining land in the reser- 6416
"voir site, for which authority from Congress will be obtained if "necessary." * * * *

"3. The City and County of San Francisco will develop the "Lake Eleanor site to its full capacity before beginning the develop-"ment of the Hetch-Htechy site, and the development of the latter "will be begun only when the needs of the City and County of San "Francisco, and adjacent cities, which may join with it in obtaining "a common water supply, may require such further development."

Then, at the end of the permit, the following:

"I therefore approve the maps of location for the Lake Eleanor "and Hetch-Hetchy Reservoir sites, as filed by James D. Phelan, and "assigned to the City of San Francisco, subject to the filing by the "City of the formal stipulation set forth above, and the fulfillment of "the conditions therein contained."

Counsel for Defendants also read a resolution from the Journal of Proceedings of the Board of Supervisors, under date of June 1, 1908, Vol 3, New Series, page 527, which resolution, after setting forth in a preamble the entire Garfield Permit, recites as follows:

"Now, therefore be it

"RESOLVED, By the Board of Supervisors of the City and "County of San Francisco that the action of Marsden Manson, City "Engineer of the City and County of San Francisco, and the duly "authorized and accredited representative of said city and county, "in petitioning the Department of the Interior for said reservoir "sites and rights of way, and expressing the stipulations acceptable "to the City, which the Honorable, the Secretary of the Interior, "prescribed as the terms of his decision, hereinabove expressed be "and are in all things approved and ratified; and, the conditions ex-"pressed in the letter of the Honorable, the Secretary of the Interior, "James Rudolph Garfield, of date May 11, 1908, to the Commissioner
6417 "of the General Land Office, above quoted, be and hereby are ac-"cepted in full by the City and County of San Francisco."

That was universally approved by the Board of Supervisors and signed by the Mayor.

Counsel for Defendants offered in evidence the complete contract, a portion of which was read by Mr. Olney on page 1381 of the transcript—for the purchase of the lands in the Hetch-Hetchy Valley, between Elmer E. Smith and the City and County of San Francisco, dated December 14, 1908, relative to lands in the Yosemite National Park.

Received and marked "Defendants Exhibit 126".

After the usual preamble for an agreement for the purchase of real estate, and a description of the real estate, in which the lands in the Hetch-Hetchy Valley are described separately from the lands outside, and referred to as inside lands, and the lands outside of Hetch-Hetchy Valley proper are referred to as outside lands, the agreement—above referred to—goes on to say, on page 2:

"And Whereas, by section 15 of Article XII of the Charter of "said City and County of San Francisco it is provided as fol-"lows: The Supervisors shall have power, in the name and for the "benefit of the City and County, to acquire by purchase, and the "general laws of the State prescribe, any lands situated within the "State of California necessary for constructing or maintaining canals,
6418 "aqueducts, reservoirs, tunnels, flumes, ditches or pipes for con-

"ducting or storing water for the use of the City and County, or "the inhabitants thereof; and

" Whereas, said City and County of San Francisco, acting by "and through its properly accredited and authorized agents or repre- "sentatives, and in pursuance of the authority of, and for the pur- "pose of exercising the rights and privileges conferred by said Sec- "tion 15, Article XII, of its Charter, said City and County has here- "tofore acquired from the Government of the United States, through "its Secretary of the Interior, among other privileges, the right to "utilize the floor of said Hetch-Hetchy Valley and necessary con- "tiguous land for the purpose of a storage reservoir to impound "water, to be thence conducted by means of tunnels, flumes, ditches "or pipes, for the use of said City and County, and has obtained "from said Secretary of the Interior a permit to so utilize said floor "of said Hetchy-Hetchy Valley for such storage purposes, and has "also obtained a similar privilege as to Lake Eleanor, and lands adja- "cent to its margin, upon the following stipulation, among others:

" The City and County of San Francisco will surrender to the "United States equivalent areas outside of said reservoir sites, and "within the Yosemite National Park and adjacent reserves in exchange "for the remaining land in said reservoir sites: And

" Whereas said City and County of San Francisco is desirous "of purchasing from said party of the first part, all and singular, "the lands and premises situated in the floor of said Hetch-Hetchy "Valley, said lands to be held by said City and County in fee simple "absolute, and for the use and purpose specified in said Section "15, Article XII, of its said Charter, and is desirous of obtaining or 6419
"securing the control of the title to those other lands in said Yosem- "ite National Park, and adjacent reserves outside of said floor of said "Hetch-Hetchy Valley hereinbefore designated as 'outside lands' in "order to enable said city and county to effect with the United States "an exchange of said outside lands for equal areas of Government "land within said reservoir site, in and adjacent to the floor of said "valley, and in and adjacent to Lake Eleanor and its margins;

" Now, Therefore, For and in consideration of the sum of Ten "Thousand ($10,000) Dollars gold coin of the United States, hereto- "fore paid by the party of the second part to the party of the "first part, the receipt whereof its hereby acknowledged, and other "considerations good, adequate and valuable, said party of the first "part hereby covenants and agrees to sell and convey to said City "and County of San Francisco, by deed of grant, bargain and sale, "all the lands and premises first hereinbefore described and desig- "nated as 'inside lands', and to make, execute and deliver such deeds, "conveyances or instruments, conveying said outside lands to either "the United States or to any person or persons who may be designated "by Edward R. Taylor, Mayor of the City and County of San Fran-

"cisco, or his successor in office, which may be necessary and requisite "under the regulations of the Secretary of the Interior, or any Act "of Congress, in order to enable said city and county to effect the "exchange of said outside lands with the United States for areas of "Government land on or adjacent to the floor of said Hetch-Hetchy "Valley, and underlying or adjacent to margin of Lake Eleanor, upon "the following terms and conditions: The total purchase price of "said lands is the sum of One hundred and fifty thousand, eight
6420 "hundred ($150,800) Dollars".

Counsel for Defendants here called attention to the total purchase price under the offer of Mr. Smith, as read by Mr. Bergen, on page 1376 of the transcript, where it was given as $150,000, and also to the fact that the acreage recited in this offer is a total of 1322 acres as against a total of 812 acres, referred to in the offer of Mr. Smith, as read by Mr. Bergen, on page 1380 of the transcript, and to that extent he stated that what he had been reading was in conflict with the offer which Mr. Bergen read.

Counsel for Defendants also introduced agreements of sale made for the purchase of the lands of Horatio Gabriel Kellett and Lizzie B. Covel, lying in and adjacent to the floor of Hetch-Hetchy Valley. He stated that these contracts show the actual consideration which was paid in each of the three cases, and the only consideration that was
6421 paid. He stated that these figure out $109 per acre, and that it was a half interest owned by Horatio Gabriel Kellett, and an undivided half interest owned by Lizzie B. Covel, and James M. Covel, her husband. Separate agreements were made for the purchase of the half interest on identically the same terms. There is only a difference of $800 in the total price from the total price mentioned in the Smith offer, but the acreage is given at 812 acres in the Bergen offer, and 1322 acres in the contract.

The Kellett agreement was marked "Defendants' Exhibit 127",
6422 and the Covel agreement marked "Defendants Exhibit 128".

Mr. Searls: I have been through the entire Journal of Proceedings of the Board of Supervisors for the years 1907, 1908 and 1909, and I can find no record of anything, except an authorization for the entry into this agreement here; also a record of the receipt of the offer which Mr. Bergen read into evidence. The Journal shows that that communication was received. As a matter of fact, the history was that they went out and took a collection of $10,000 to make the first payment on this contract, until they could get a bond issue up, because their rights would be liable to lapse. That is, the time for payment would elapse before they could get the bond issue through, and the Auditor held that the City had no right to spend the money in that way out of the regular budget.

Witness: DRENZY JONES for Defendants.

DIRECT EXAMINATION BY MR. SEARLS.

I am 57 years of age, reside in the City of San Francisco, and am a surveyor and civil engineer by occupation. I am assistant engineer with the city government, and have been in that position since June 29, 1908. I know Marsden Manson, former City Engineer of the City of San Francisco, and he took office January 9, 1908. I was Assistant Engineer under Mr. Manson. 6423

During the year 1908 I was engaged in making surveys, and gaging the amount of water flowing in the Tuolumne River. During that year I made surveys to locate the patented lands which the city proposed to acquire in and adjacent to the floor of the Hetch-Hetchy Valley, and also the patented lands outside the Hetch-Hetchy Valley, which it was proposed to acquire. I have prepared a map showing the location of the lands in and adjacent to the floor of the Hetch-Hetchy Valley, which is the map you are showing me, entitled "Hetch-"Hetchy Water Supply of the City and County of San Francisco, "lands purchased by the City and County of San Francisco for Hetch-"Hetchy reservoir site". The heavy white lines indicate the exterior bounds of land purchased by the City and County of San Francisco 6424 from Elmer E. Smith, Kellett and Covel, and that delineation is based upon field notes in my possession.

The traversed line on the map indicates the portion of the flood line of the survey of 1901 by H. E. Green for James D. Phelan, applicant for rights of way. That is not the present flood line of the Hetch-Hetchy Reservoir, but was the flood line for which application had been made to the United States, and which application was granted by the Garfield Permit. The present flood line was made under the direction of Mr. Freeman, in 1912, and also under the direction of Mr. O'Shaughnessy. The present Freeman plan for the development of the Hetch-Hetchy Valley and the Tuolumne country had not been thought of in 1908.

The table in the lower part of the map shows the areas of the inside of the flood line represented here, and also the areas that would be on the outside or patented lands purchased by the City of San Francisco. It shows a total acreage of 720 acres of patented lands, of which 478 are within the traversed flood line of the reservoir then proposed, and 242 acres which are outside.

This map intrdouced and marked "Defendants Exhibit 129". 6425

Mr. Searls: The patents marked "N. Screech" and "J Screech" were predecessors in interest. Smith owned the two subdivisions marked 7770 and 7792 at the time the contract was made, and they are the inside lands covered by the contract together with 7646.

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Jones: The map marked "Administrative Map of the Yosem-"ite National Park" is an official map of the United States Geological Survey of the Yosemite National Park. The areas shown in red, green, and yellow thereon were placed there under my direction. The red areas show the lands purchased by the City and County of San Francisco from Elmer E. Smith, Kellett and Covel, and all of those outside lands marked in red, of the Hetch-Hetchy Valley proper, were in-
6426 cluded in the Elmer E. Smith purchase. The parcels marked in red, beginning with the most northerly parcel, are commonly referred to as Tilltill Valley, Hetch-Hetchy Valley, Canyon Ranch, Hog Ranch, Middle Fork Homestead, or Ike Die place. The areas marked in green show the lands purchased by the City and County of San Francisco around Lake Eleanor from the Tuolumne Water Supply Co., and the areas marked in yellow show lands in the Cherry Valley and Cherry Creek Watershed purchased by the City and County of San Francisco. The lands about the lake, possibly in the lake, were public lands of the United States Government, and those lands in and about Lake Eleanor belonging to the Government were among the lands for which the City of San Francisco was required to exchange other lands.

6427 This map introduced and marked "Defendants' Exhibit 130".

Referring to the Smith, Kellett and Covel purchases; I was familiar at the time the negotiations were pending with the use to which those lands outside of Hetch-Hetchy Valley were to be put by the City, and I acquired that familiarity from consultations and conversations with the City Engineer, and with members of the Board of Supervisors. I was, at that time, under Mr. Manson, in charge of the preliminary work on the Hetch-Hetchy project. I accompanied the Board of Supervisors on the trip which they made to Hetch-Hetchy Valley in the Summer of 1908, and was also with them in their special meetings and consultations. I did not hear any conversations at any of the meetings or formal consultations which were held in the valley on the part of any of the Supervisors as to a segregation between the values of lands or the prices to be paid for lands inside the Hetch-Hetchy Valley, and the prices to be paid for lands outside the Hetch-Hetchy Valley. I never heard Mr. Manson say that in his opinion the lands inside the Hetch-Hetchy Valley were more valuable
6428 than those outside the Hetch-Hetchy Valley on account of their reservoir use.

I am, in a general way, familiar with the agricultural value of lands in the region of the Tuolumne Watershed and the Hetch-Hetchy Valley, which familiarity I acquired through making surveys throughout that country, and getting values regarding the tax assessments, and from general conversation and rumor. It is my opinion, that

the value of the lands covered by these purchases from Smith, Kellett and Covel is, for agricultural uses, or for uses other than as a reservoir, about $25 an acre. The fact that the city paid an average price of $114 an acre for the Smith land, and $101 per acre for the Kellett-Covel lands, was due to the fact that strong opposition came up against the City of San Francisco and the City Engineer, and 6429
other city officials were very anxious to close the deal. There was very little time left to hunt other lands, and the abstract was ready; it was a case of actual necessity. Also the conditions of the Garfield Permit, which recites that the City of San Francisco practically owns all of the patented lands in and adjacent to the floor of the Hetch-Hetchy Valley, and also the provision that it will acquire other lands and exchange with the Government acre for acre for lands within the area of the Government lands to be flooded, had something to do with the haste in which the City appeared to be in acquiring those lands. From my familiarity with the negotiations at that time I know that that requirement forced the purchase. 6430

CROSS EXAMINATION BY MR. MCCUTCHEN.

These lands range at an elevation of from 3500 to 4000 or 4500 feet. The most westerly of the tracts in red, the Ike Die place, on the middle fork, I have no exact data on, but I should judge it should be about 3000 feet in elevation. The Hog Ranch is 4500 feet, and the elevation of the next place to the north and east, Canyon Ranch, 4800 feet. The place on the middle fork is worth, I should judge, $25 an acre for agricultural purposes. You could raise grain of any kind on that. It's topography is rolling. The Hog Ranch is worth $25 an acre for agricultural purposes, such as hay and grain. You can raise hay and grain on possibly 110 or 100 acres out of 322 and a fraction acres. I believe that when that land was being farmed there were 110 acres in hay, and we cut, I believe, 40 tons one year from about 110 or 115 acres. We did not plant 110 or 115 acres, but we actually cut that number of acres, which was meadow land. It 6431
was largely covered with large boulders, but we cut in among them with the mowing machine. About 60 acres of that 110 acres is free from boulders so that it could be plowed. The balance of the 110 acres could be cultivated, but probably not to as great advantage as the remainder could be cultivated. The value of that 110 acres for agricultural purposes, per acre, would depend entirely on what you were going to do with it, but the utmost I believe it could be would be possibly $50 an acre for all the 110 acres, and that would be a general value. It would require an expert in farming to say for 6432
what purpose it would be used to make it worth $50 an acre. I am telling you the value of this property for agricultural purposes as far as I know it, and I would not be competent to say for what purposes it would be used that would make it worth $50 an acre. As

to where the market would be for the produce that would be raised
upon it would be a matter of circumstance; mining might develop
in that country, or the country might be abandoned, or the forest re-
serve might be extended.

The nearest activities in mining to the Hog Ranch would be on
Jawbone Creek. There were mines operating there about 2 years ago.
That is, there were some prospectors there, but I do not know what
the results were. There is also prospecting to the south and to the
6433 west. The nearest railroad station to the Hog Ranch is Chinese, which
is about 40 miles distant, and the Priest Grade which was formerly
there has been eliminated by a new grade of about 7%. It is all
pretty good road. In an ordinary season the snow is on the ground
at the Hog Ranch until the middle of March, and I have seen it in
patches later than the middle of March. I have seen it on this
flat land later than the middle of March to such an extent as would
prevent cultivation of that land, but I should judge to warm up the
land and have it ready for plowing you would not commence plowing
before the middle of May. The snow begins to fly, as a rule, about
Christmas time, although there might be a flurry earlier than that,
and then melt off again. A cold snap—freezing weather, comes some-
6434 times in October, and it is possible that they do not have killing frosts
earlier than the first of October.

The hay crops raised in that country are not planted every season;
it is timothy, which is planted possibly once in five years, and that
timothy begins to grow up through the snow before the snow goes off.
I do not think I would plant grain on the Hog Ranch, unless it was
barley or some of the hardy grains. As to the market for the timothy
hay grown on the Hog Ranch, the City of San Francisco has sold
hay to contractors in the vicinity who were doing grading work for
the City of San Francisco. There is also the entire Yosemite Valley,
and the different stage stations between Chinese and the Yosemite
Valley that generally buy hay. The railroad is into the Yosemite
Valley now, and freight has not recently been sent over the stage
6435 road, destined for the Yosemite Valley. Hay grown on the Hog
Ranch could not be hauled into the Yosemite Valley and sold for
less than hay bought in the San Joaquin Valley and sent by rail
to the Yosemite Valley, but what might be profitable to a farmer
on the Hog Ranch might not be profitable to a farmer down the San
Joaquin Valley, or for those who would be on the way up. I do
think that the land has a value. Not necessarily because some-
thing could be raised on it that would find a market in the Yosemite
Valley only, as there are other places.

The Hog Ranch is about 12 or 14 miles from the Big Oak Flat
road. I could not say offhand how far it is from the Yosemite Valley.
There is a fairly good grade going into the Yosemite Valley from
there. There is a considerable difference in elevation after you leave

the Hog Ranch before you get to the top of the mountain going down into the Yosemite, but the grade is not bad. The high point is about 6400 feet on that road. One way to get to the Big Oak Flat road is 6436
to go to Crockers, but that is not the best road at present. For light wagons, and for general pleasure, you take the road to Red Hill; it leads down to a point about half a mile from the toll bridge. If you were freighting, you would go to Crockers, which I judge is lower than the Hog Ranch.

I would not make any other statement in regard to the value of the remaining 210 acres of the Hog Ranch, per acre, than I did, that generally all through it is worth about $25 an acre. The 110 acres of it that I have spoken of is worth approximately $50 an acre, but to ascertain what the other 210 acres is worth per acre would require a survey, and sometimes a calculation. The land is not so good, and it has other value, such as timber value. It is not, as a rule, scrubby timber, nor is it as a rule fine timber. In some parts it was extra timber, and in other places there is no timber on 6437
it. The timber consists of sugar pine, yellow pine, incense cedar and oak, and as to what the two latter would be worth for timber purposes would be according to judgment; whatever the demand might be. It would have appreciable value for fencing, and I think the proper way to get at the present value of incense cedar for fencing purposes would be by the rates charged by the forest service; they have a schedule for that. I could not say how much of a demand there is for incense cedar for fencing in that country.

The timber on the Hog Ranch is in patches, but there is some good timber there. Whether or not, looking at it as a timber proposition, the whole Hog Ranch would be worth $500, would be entirely 6438
according to the demand and what the timber was used for. The City might certainly use all the timber they have there.

A portion of the 210 acres—which 210 acres is a portion of the 320 acre tract, exclusive of the 110 acres of flat or bottom land—has a value for agricultural purposes if it were cleared. It is not cleared, and the cost to clear it would be a question that I would have to segregate. If the 320 acres includes stock raising along with its value for agricultural purposes, I would pay $1,000 for it. The best stock we can raise up in that country is Devonshires and Holsteins. I don't know who raises them in that vicinity, but they have good cattle in that country, and that 320 acres would provide, with the contingencies, for 4,000 head of cattle. The contingencies are the right to the public domain lands in the vicinity, and to have the first choice from the forest reserve. If you had 6439
the 320 acres in the Hog Ranch only, it would be problematical as to how many cattle that would support for a year, but the land is worth $25 an acre as a cattle ranch. You can keep cattle there the entire year, and feed them on hay. That is, you would have to pro-

vide hay during the growing season, and put it away to feed the
cattle during the winter. I came from a country where possibly
there were more cattle raised than in the State of California, and
they did that. I think that in this country that we are speaking of,
in the Sierras, they keep some milch cows for family use during the
winter. I would not call that a stock ranch, and I do not know
of anybody keeping cattle, excepting a cow possibly, for family
6440 use, at an elevation comparable to that during the winter, but never-
theless that land would be worth $25 an acre for stock purposes.

I cannot recall any sales, in my experience with lands of this
character, at $25 an acre, but of course I will qualify all that by
saying with the contingencies, and that means that a man can have
a ranch down in the lower country and take the cattle down.

I have been in California since September, 1876, and have
known the Sierras about 20 years, and I feel that I know them
pretty well. I do not know of a sale of agricultural property in the
Sierras at an elevation of 4500 feet at $50 an acre. It is possible
that some lands of this character in the Sierras have been sold at
an elevation of 4500 feet at $20 an acre, such as the Crocker-Sierra
Resort, but it had the contingencies that I speak of, and also was a
resort for tourists. I think the Hog Ranch could run in opposition
6441 to Crocker's successfully with proper buildings, roads and trails to
go to the Tuolumne River, Smiths Peak, and other attractions. When
I put a value of $25 an acre upon the Hog Ranch, I was not induced
to do so by the fact that it could be used as a resort. I do not
think it is worth more than $25 an acre for agricultural purposes.
The fact that it could be used for a resort brought out more value
to it.

I would put the Canyon Ranch in the same category as the Hog
Ranch as to its value per acre. It is about 4800 feet in elevation,
and worth $25 an acre. There is very little tillable land at present
on it; most of the meadows have grown up with cedars and pines,
and small trees, but if that land were cleared it would be very good.
The meadows could be cleared for $50 an acre, but portions where
the trees have grown up large, I do not think could be. The Canyon
Ranch has value for timber, yellow pine, cedar pine, cedar oak,
6442 some of which is large timber, and most of it virgin forest. About
one-third of that land is covered by large timber, and the other two-
thirds by smaller timber, which smaller timber would have value
for lumber purposes. Mining poles run from 5 inches, you might
say, to 12 inches diameter at the butt. I have seen mining timber
5 inches at the butt on the Mother Lode, through Calaveras, Mari-
posa and Tuolumne Counties. The smaller timber on the Canyon
Ranch has a possible value, and that land is worth $25 an acre for
the timber on it, chiefly, and it would have that value to any person
who wishes to have it cut or use it. Whether I would buy it at

$25 an acre, if I were in the market for timber land, would be according to what I wanted to use the timber for. I would certainly pay $5 an acre for it, if I were in the market for timber land, if certain restrictions were eliminated from the Park. I would have paid $5 an acre for it for timber purposes under the con- 6443
ditions that existed at the time that San Francisco bought this property, and I would have used the timber for construction purposes, such as construction of the ultimate dam that would be at the Hetch-Hetchy dam-site. If I had known that San Francisco were going to build a dam, I would have paid $5 an acre for that land for timber purposes, as there is a vast amount of cedar, pine and good timber in that country, and it is not going to remain idle there always. You would find a market for that timber when a railroad is constructed in there, and a sawmill put in, and I would have paid $5 an acre for it in anticipation of the coming of a railroad, and others have paid more than that in that vicinity. I think I would take a chance on $5 an acre for that land, notwithstanding the fact that all the property around it was a National Park. I cannot say that because the remainder of that country is in a National Park there would be no inducement to anybody to erect a sawmill there, as the restrictions might be relaxed, and a man might have a chance to get the timber out. There are other patented 6444
lands in the Yosemite National Park.

The yield of lumber per acre on the Canyon Ranch would run high, and I would say that the entire 160 acres would produce about three million feet. I had it cruised by employees of the City and County of San Francisco after the purchase was made. I believe it was understood at the time this purchase was made that the City would cut the timber before the exchange would be made, or any particular use they wished to put it to. I do not think the City could put the land to any use after it got it, as the police provisions of the park would not permit it, but I think that at the time the purchase was made the City was induced in part to make that purchase because of the timber on the Canyon Ranch. I would not say that the City would not have bought the Canyon Ranch, except for the timber that was upon it, as they did buy it for the purpose of exchanging it with the Government for other lands, and that was the chief reason for which it was bought, but the existence of the timber, I think, was an inducement. 6445

I believe, so far as the exchange of lands was concerned, that the City had to buy lands that would be equally valuable in order to make the exchange. I believe that was the general conclusion that the lands would be such as could be used again for camp sites and general resorts throughout the mountains. I cannot remember who told me that, but I did hear that one of the inducements to the Government to make the exchange was that the City

should buy land of a particular kind or quality, or description. No representative of the City ever told the Government that the lands which the city would acquire and turn over to the Government would have timber upon it, or would be available for agricultural purposes. It would be land that could be used for camp sites, equally good, either with the floor of the Hetch-Hetchy
6446 Valley, or lands about Lake Eleanor. I know that the purpose of the Government in requiring that exchange was simply to eliminate private ownership within the confines of a national park. I think there had been conversations, and tentative agreements long before the grant was allowed, and one of them was that it should be good land, land that would be equally valuable for camp sites; that appeared to be the question, eliminating campers from the Hetch-Hetchy Valley and about Lake Eleanor. This would give them an equal advantage.

I do not think you could buy the McGill Meadows for $25 an acre now, nor could you buy the 80 acres in the Poopenaut Valley for $25 an acre. Most of the 80 acres in the Poopenaut Valley is not worth as much as at the Hog Ranch. I would not make an answer as to what I would advise the City to pay for the 80 acres in the Poop-
6447 enaut Valley. I have heard that those in authority, representing the City of San Francisco, want the 80 acres in Poopenaut Valley, but I cannot tell you what I would advise the City to pay for it; it is entirely problematical. Taking all the problems into consideration, I
6448 might state that those 80 acres were originally purchased for about $300, and inflated in value as opportunities showed they might possibly get more for it from somebody. Of the 80 acres in the Poopenaut Valley there are 33.9 acres of agricultural land, worth about $25 an acre, and I think it is fairly good agricultural land. For some purposes it is better than in the Hog Ranch. If the purchaser should want to raise some grain for experimental purposes, it is lower in elevation and warmer, but the land is more sandy, so that is offset just about the same. I think the soil on the Hog Ranch is better than the soil in these 33 acres in Poopenaut Valley. I am not a soil expert, but I have seen some strawberries growing at the Hog Ranch, and they impressed me that the soil was very rich. I have never seen any strawberries growing in the Poopenaut Valley.

Poopenaut Valley is nearly 2,000 feet lower in elevation than the Hog Ranch. There is no wagon road leading out from Poopenaut Valley, so that it is impossible for me to say how much nearer it is to a railroad station than the Hog Ranch. It is possible to
6449 reach Poopenaut Valley by wagon, but not practicable. I should judge that it is approximately 25 miles from a railway station. The nearest existing wagon road from Poopenaut Valley would be not over a mile and a half away.

The 33 acres in the Poopenaut Valley is worth $25 an acre, not

including the inflated value for reservoir site, or for other purposes, but considering it for agricultural purposes. Considering it for 6450
reservoir sites, the 33 acres in the back might be worth more than $25 an acre, but how much more would depend on whether the reservoir was to be built immediately, or whether it would take time. If it were going to be built immediately, and they needed it very badly, it would be worth very, very much more for reservoir purposes than for agricultural purposes. Land that is available for reservoir purposes, and also available for agricultural purposes is not always worth very much more for reservoir purposes than for agricultural purposes. There might be some valuable land for agricultural purposes that would be near markets that would be worth more. Again, if the reservoir were a good financial venture—some reservoirs are not worth the dam that is built. There are too many conditions in that to answer definitely as to what are the exceptions to that rule. I will qualify my last answer by saying that I 6452
have not made sufficient study of the reservoir land valuation to state the exception to the rule that land available for reservoir purposes, and also available for agricultural purposes is not always worth very much more for reservoir purposes than for agricultural purposes.

A portion of the 80 acres referred to in the Poopenaut Valley are available for reservoir purposes, but there is not a present demand for them for reservoir purposes. I have not given it sufficient study to state whether they are very much more valuable for reservoir purposes than for agricultural purposes, even though they are sought by a purchaser who anticipates using them for reservoir purposes in the future.

I would say that using the valuation placed by the United States Government, the lands covered by the Hog Ranch, the Canyon Ranch, and the middle fork lands, were of equal value per acre with the lands in Hetch-Hetchy Valley; they were willing to exchange. I have been giving my own opinion about values, and my own opinion was that the lands covered by the Hog Ranch, Canyon Ranch, and the Middle Fork Ranch, were worth $25 an acre for agricultural purposes.

(Counsel for Plaintiff, at request of Counsel for Defendants, acknowledged that it was understood that all of this testimony is subject to his objections that it is not proper cross-examination.)

In answer to your question, "whether the lands in Hetch- 6453
"Hetchy Valley were worth more or less than the other three prop-
"erties referred to for any purpose for which they might be avail-
"able," I would fall back on that same answer that the Government was willing to exchange; for what purposes they would be, would take a lot of study of the conditions and the situations. I will say that they were thought to be the same value.

The Hog Ranch and the Canyon Ranch are available for agricultural purposes, and possibly for timber purposes, and there are possibly two million feet of logs in the floor of the Hetch-Hetchy Valley now. I think that the presence of those logs adds in value to those lands on the floor of the Hetch-Hetchy Valley to a purchaser for the purpose of fire-wood, shade-trees, and the possibility of a dam being built at the Hetch-Hetchy dam site would give value to that timber. The same possibilities would not give value in the same ratio to the land on which the timber was growing, but if a private owner held the land, and the trees on it, he would possibly be more apt to sell to whoever would construct the dam, and who-
6454 ever would construct the dam would have more difficulty in getting a permit for that purpose; that is the difference. Assuming that the permit were obtained or could be obtained, I think offhand that the land on the floor of the valley would have greater value for reservoir purposes than for agricultural purposes, but there are so many conditions mixed in with it, such as permits from the Government, restrictions by the Government, it is in a park, and in a place where no man can forsee what is going to happen next. If it was in a public domain, it would be different from what it is in the park, but in the park it is hard to state what is going to happen. That land on the floor of the valley has a greater value now for reservoir purposes than it has for agricultural purposes, but it did not have at the time the land was purchased, and when I say purchased, I mean at the time the option was taken. The City took the option at that price, because there was a chance, and a good chance to prevail upon the Interior Department to grant that right of way, and they felt sure, and I, as a city officer knew
6455 to my own satisfaction that if that permit could be granted, that land in the floor of the valley was worth very much more per acre for reservoir purposes than the price which the City was paying for it.

Mr. Searls: The date of those contracts was December, 1908, and this closed the purchase; I don't know just when the deed passed.

The Master: The other two, Kellett and Covel, were in February, 1908—that is, the agreement was.

CROSS EXAMINATION BY MR. MCCUTCHEN.

Mr. Jones: After the City got the permit to go ahead, I am positive that as a business venture, the land outside of the Hetch-Hetchy Valley was worth $5 an acre, not only to the City, but to anybody. That is to say, at the time this Smith contract was made, those lands were worth more than $5 an acre to anybody. $10 an acre, in my opinion, would be as much as the Hog Ranch,

Canyon Ranch, Tilltill Valley, and the Middle Fork Ranch, could be worth in the open market.

Mr. Searls: So far as the City of San Francisco is concerned—and I know this, because I am personally connected with the negotiations—the present situation in the Poopenaut Valley is not a 6456
proposition of acquiring a reservoir site as much as getting certain people out of there who may interfere with the purity of the water supply at the time they come to use the water, and also divert certain quantities of water that we claim under our appropriation. The City has no intention, so far as I know, or from anything of record I have seen, of building a dam in the Poopenaut Valley.

Mr. McCutchen: It is a current rumor that the corporation that owns Poopenaut Valley, or those particular 80 acres, expects that it will convert that valley into a reservoir, and that it is asking a price that would mean at least more than $1,000 an acre for the land.

Mr. Searls: They have not stated any particular price to us, so far as I know. They want to sell out water rights and everything else to us, at some figure, I suppose, approaching the figures at which they capitalized the scheme, but they have not named it.

Mr. McCutchen: Of course, it would not make our lands any more valuable, but I understand that they were asking $800,000 for the land in the Poopenaut Valley.

NINETIETH HEARING. FEBRUARY 3, 1916.

Witnesses: H. L. Haehl for Defendants.
Geo. L. Dillman for Defendants.

Mr. Metcalf inquired of the Master, on the question of pumps, as 6457-6460
to whether he would deem it necessary to have the segregation as between the pumps and the boilers, and so on, or whether he would be content to take the footing at which the parties have arrived by stipulation for the various pumping stations. Also whether the Master would feel it to be sufficient to finally form his judgment as to depreciation on the evidence that might be adduced in regard to the average percentage of depreciation at the various stations, whatever it might be, as testified to by the various witnesses. Before making a final decision, it was decided that Counsel for Defendants should confer with Mr. Dockweiler and Mr. Dillman.

The Master referred to page 6428 of the transcript, whereon a 6461
question was put to Mr. Jones on cross-examination, calling for an expression from him as to the reason for paying a certain price for the Smith, Kellett and Covel lands as a whole. The Master stated that he doubted the correctness of his ruling, and therefore wants

to know what areas those Smith lands for $114 an acre, and the Covel-Kellett lands for $101 an acre, cover, and also whether they are outside lands or reservoir lands.

Mr. Searls: The Kellett-Covel lands are all within the Hetch-Hetchy Valley and the adjoining country; they are not all within the reservoir. The Smith land at $114 an acre is an average price for all the lands in the Smith purchase, including those in the Hetch-Hetchy Valley, and those outside, it being our contention that no segregation was at any time made. In other words, those figures cover both reservoir lands and outside lands in each case.

6464-6465 (The report of Mr. Schussler to the president and directors of the Spring Valley Water Co., made in 1887, as to detail work that had been done in preparation for the Crystal Springs Dam, and estimating its costs, was offered in evidence at page 6129 of the transcript, by the City. On reserved ruling the Master announces that he will admit this report as some evidence of what the original cost was. It was accepted and marked "Defendants Exhibit 131".)

6465-6466 (The offer to read into the record certain testimony of Mr. Schussler in the case involving the rates of the year 1903-04 is rejected, and the reasons therefore recited.)

6468 Witness: H. L. Haehl for Defendants.

Haehl

DIRECT EXAMINATION BY MR. SEARLS.

I am 39 years of age, reside in Palo Alto, and am an hydraulic engineer by occupation. I am chief engineer of the Bay Cities Water Co., and have held that position since about 1910. Prior to that time I was connected with the company since 1903 as assistant engineer. I am familiar with various reservoir sites owned by the Bay Cities Water Co., and acquired that familiarity by reason of my duties with the company, which made it necessary for me to direct the surveys which were made on these sites; also to direct the work of exploration, the measurement of stream flow, evaporation and rainfall. I have been over each of these sites personally, and the names by which they are known are the names set forth in the first column in the table I have before me. Those sites were purchased for the most part in 1903, but partly in 1902. I was connected with the company during the period in which practically all these purchases were made, and at the time they were made I was generally familiar with
6469 the character of the land which was included in the purchases. The second column of this table describes the general character of this land as nearly as I could describe it in a few words. The third column of the table purports to set forth the nature of the title which the company acquired, and the source of that information were the books of the company. The fourth column purports to show the

acreage of each reservoir site acquired in fee, and the acreage in easement, which information was also obtained from the books of the company.

The acreage referred to in the fourth column includes in each case the entire purchase made by the company in order to obtain a reservoir site, and in most cases a portion of the lands included in those acreages were not to be flooded. In the case of the Laguna Seca practically all would have been flooded; there is a small acreage that would not be flooded in that case.

At the time the purchases were made by the company there was 6470
no distinction so far as the records show, or so far as I am aware, made between the price paid for the portion of these lands which were to be flooded, and the price of the portion which were not to be flooded. The figures in the fifth column, showing the total cost of the various acreages, were taken from the books of the company.

Questioned by Master.

The range of dates of the purchases was from 1902 to 1904.

DIRECT EXAMINATION BY MR. SEARLS.

Referring to the fifth column, an item of $46,000 in bonds which was paid for portions of the Arroyo Valle, Santa Isabella, and Bonita reservoir sites: I considered the bonds at par, but I have no idea what value was placed upon the bonds by the party who sold the properties.

The sixth column is obtained by dividing the fifth column by the fourth column, and shows the average price per acre so far as it relates to fee lands; that is to say, it is the division of those columns with reference to the lands in fee. I have no information which would 6471
enable me to segregate the cost of the fee of the lands under the Arroyo Valle, Santa Isabella and Bonita reservoirs from the cost of the easements to flood and water rights. In most cases, and particularly in this case, the sum was paid for the entire lands including the easements, and there was no segregation made in the purchase as between easements and fee land.

I had a general familiarity with the value of lands for agricultural purposes in the vicinity of these reservoir sites at the time 6471-6472
they were purchased, namely, 1902 to 1904. I acquired that familiarity by reason of my connection for the last 13 or 14 years with these properties, and my work upon them, and my familiarity with the prices asked, and the offers made with respect to properties similar in nature, and in the same general localities, by reason of information gathered by me in the course of my duties at the request of the company in several instances, where I was requested to ascertain the value of these lands, or certain portions of them, and on which occasions I took steps to have appraisals made, and gathered informa-

tion of whatever sort I could concerning the agricultural value of the lands belonging to the company.

(The following answer was given subject to a deferred ruling on the properness of its admissibility.)

6472-6475 Column seven on this table correctly expresses my opinion of the general range of agricultural values of these lands. The second part of column seven; "average for fee only", was secured by applying the various values to these tracts within the range shown in the
6476 first portion of column seven. In other words, it is a weighted average based on my assumption of the number of acres of each class of land. The total value was therefore being divided by the acreage. In most cases, and in the case of the San Felipe Ranch, the range of values was placed there merely as indicating the extreme type of land. In the case of the Laguna Seca, in computing the value of the property, I segregated it into acreages and types. In the case of the San Felipe Ranch, which embraces those reservoir sites, I adopted a value for the entire property based upon my judgment of it at the time it was purchased. The property has never been surveyed in such a manner as to be able to say definitely how many acres there are of agricultural lands with any exactness. I am able, roughly, to say within perhaps a few hundred acres of each type of land. For that reason it was utterly impossible for me to take more than the sum total of the value of the property and divide it by the acreage in each particular case.

Questioned by Mr. McCutchen.

There is no segregation on the books of the company as to the types of land. It depends entirely upon my personal knowledge
6477 of the property.

DIRECT EXAMINATION BY MR. SEARLS.

Column 8 is obtained by applying column 6 to the second part of column 7.

The Master: Mr. Searls, what do you consider this table shows? As far as I can see, the important matter in this is column 8; the rest of it is simply detail. Where the witness finds it impossible to segregate, I do not get anything out of that detail at all.

Mr. Searls: No, sir, and I don't think anybody can. My only purpose in asking the witness to include this was to show the Court and Counsel we were not trying to hold back anything, that we had given all the information here we could get. That was all.

Questioned by Master.

Mr. Haehl: The Laguna Seca tract consists of an area of swamp and overflow land, bordered by an edge of agricultural land, and that
6478 by some hillside slopes. The general location of that reservoir is just west of the station of Coyote, on the Southern Pacific Railroad, 12 miles south of San Jose. The acreages, as nearly as I could de-

termine them, were 60 acres of agricultural land, which I valued at $200—this is rich alluvium valley land; 280 acres of swamp and overflow land which I valued at $50; 130 acres of sloping land sloping from the swamp land up to a slight distance along the sidehill, which I valued at $25 an acre. Those acreages and those prices make up a total of $29,250, which, divided by 470 acres in the tract, gave me an average of $62.30.

The Master: I think that Mr. Heahl has done his best with this problem, but I doubt, Mr. Searls, whether there is anything there of any scientific value. When you take, for instance, the first problem, you have paid $17.36 for a piece of land ranging between $5 and $100 for agricultural purposes, and which Mr. Haehl, just by a rough exercise of his judgment, thinks is worth $15. I don't see how Plaintiff can possibly cross-examine him on that, in the light of his testimony, or how I can determine whether he is right in saying it is $15, or not.

Mr. Searls: I think your Honor can at least determine this: That where they put an average price of $17.36 for land, there cannot be any great radical difference between the agricultural value and the reservoir value, and that Mr. Haehl's figures here may be taken as some kind of an approximation. I admit that you cannot get the thing accurately.

CROSS EXAMINATION BY MR. McCUTCHEN.

Mr. Haehl: About 1,745 acres of this San Felipe Ranch would 6479
be covered by the water surface. The amount of the total purchase, 11,490.02 acres is given in column 4, and as I make it, roughly, the percentage of that purchase for reservoir purposes was 15.2%. The company bought the whole tract because it wanted to buy part of the land, and for no other reason except that it desired some use of the remaining portion of the land for conduits and rights of way, and that sort of thing. Beyond such uses as that, which also ought to include the protection of water supply, the remaining land was watershed land adjacent to the reservoir site. I would say, offhand, that 2,000 acres out of the 11,000 do not drain into the reservoir. It is my impression that 9,000 acres do drain into the reservoir, and for the other 2,000 acres, the company had absolutely no use for water supply purposes. It had no use for the 2,000 acres, except as an investment in agricultural lands. I know the main purpose in ac- 6480
quiring the ranch was to secure the reservoir site on the property, but I do not think one could neglect the agricultural value of the balance of the land. I know that the Bay Cities Water Co. was not in the business of acquiring agricultural land, but to say that I know that the one and only inducement to the company in making that purchase was the fact that this reservoir site was upon the land is putting it a little strongly. I agree to that, if my agreement is

6481 not interpreted to mean that the company had no use for the remaining portion of the land, having been forced to take the remaining portion in order to secure the reservoir site. It was forced to take the remaining portion of the land in order to get the reservoir site. If you add to the fact that if the company could have acquired the 1,700 odd acres which would be covered by water without buying the remaining 11,000 acres, that it could also have secured the right of way for pipe lines and conduits, and such water rights as might go with the land, I will say that it would have done so.

I do not recall any talk at that time that the grantors of the company had put an exceedingly high price upon the property as a whole, because it was realized that if the Bay Cities Water Co. went on with its plan of operation it must have that property. As a matter of fact, I rather felt somewhat to the contrary at the time, that the company was acquiring something at very little in excess of its real value.

The San Felipe reservoir site is contained wholly within the tract, and has never been anything more than a site, which is true
6482 of all these other properties that were acquired in 1902 or 1903.

Q. (McCutchen): If the company had sources of supply with which to fill a reservoir of the capacity of the reservoir which was contemplated to be constructed upon the site within that San Felipe Ranch at the time that the purchase was made, and came to you and said "Now, Mr. Haehl, we have an opportunity to sell this property "for $500 an acre, but if we do sell it, we will have to get a reser-"voir site elsewhere", would you have advised the company that in your opinion a sale of $500 an acre was a good sale for it to make?

Mr. Haehl: I will confess that I am utterly unable to answer
6483 that question, for the reason that it would involve a great many things that are not stated, such, for example, as the character of sales the company might make of that water, what it might get for it, what it might cost to develop it, what its opportunities for continuance in business might be, and almost innumerable elements that it seems to me would enter into that problem, and which are not stated by you, and which I cannot assume.

Q. (McCutchen): Let me state to you one further element, and see if that affords you a basis. Suppose that at that time that land had been available for reservoir purposes to a company engaged in supplying the City and County of San Francisco with water, and that there was actually a demand for all of the water that could be impounded in that reservoir, and the company, under those circumstances, were to say to you, "Mr. Haehl, we have an opportunity to "sell this land for $500 an acre, but if we do, we will have to get "another reservoir site", would you, under those circumstances, have advised the company to sell it for $500 an acre? A. I cannot say that that alters my reply, Mr. McCutchen. You have stated one

other condition out of innumerable conditions which would surround the question, and it still leaves it impossible for me to reply to it. I don't understand whether you mean if it would receive $500 an acre for the entire tract, or $500 an acre for the portion of it which would be flooded, or whether or not it would be possible to get another reservoir site so as to use the same waters, so that the company could avail itself of the water rights which you have indicated it has. It seems to me the entire matter is too indefinite to reply to.

The fact that the company could, or could not get another reservoir site might weigh largely with me in determining the value of 6484
that particular land for reservoir purposes in the event that it disposed of this reservoir site in such a way that it could not secure it again; in other words, if it disposed of it to a competitor, or to someone who might utilize the waters which it otherwise had. If it disposed of the land so that it could be secured again by condemnation, that would be another angle. If the land were available for reservoir purposes, and I did not know of any other land equally available, I would be influenced by that in the advice which I would give to the company as to the propriety of selling it. There are three or four reservoir sites upon that stream, but it is hardly likely that you can impound as much water in one as in the other, or can convert them into reservoirs at about the same price, or at the same price, although I do not definitely know that some of them cannot be availed of as cheaply as this one.

I have been in touch with the water situation for 10 or 12 years, and very generally speaking, I know that reservoir sites within 50 to
75 miles of San Francisco are scarce. I am not prepared, and there- 6485
fore would not care to say anything which would indicate preparation on my part as to the value of reservoir lands. That is a subject, it seems to me, that is too deep to give a horseback opinion upon, so to speak, and that is all I would be able to give at this time. This table was prepared merely to show facts with respect to certain reservoir lands, and nothing further was asked of me. It was prepared with a view to showing the cost of land purchased for reservoir purposes within the area of operation of the Bay Cities Water Co.

I don't recall the exact date that I became the chief engineer 6486
of the Bay Cities Water Co., but it was approximately in 1910. Prior to that I was an assistant engineer, and while assistant engineer, I had nothing to do with the payments upon lands, but I was asked to investigate lands, and determine whether or not reservoir sites existed upon them, and to direct surveys with reference to their extent and character, and so on. The books of the Bay Cities Water Co. are the chief source of my information as to the prices paid for these lands, and I did not get my information from any other source. I do not mean to indicate that I have not any knowledge
derived from discussion with officers of the company as to what was 6487

paid for things generally, but this particular information put down here was taken from the books of the company, and did not depend on any hearsay.

I believe I could, in the case of the San Felipe Ranch, estimate within several hundred acres at any rate, what proportion of the land would fall under the minimum valuation, and what proportion would fall under the maximum valuation, and I could probably estimate within perhaps 10 or 20 acres in the case of the Uvas Creek tract, but it would be an estimate, and would not be based upon actual survey, because that, so far as I know, has never been done.

The San Felipe Ranch is sometimes known as the Webber Ranch. There are several tracts which come in under the Webber purchase; one known as the Glen Willis tract. The sum of $199,500 includes nothing except the payment made to Mr. Webber and his wife, and none of these cash costs given here include anything but similar payments; it does not include the cost of the abstract of title, or the recording fee, or examining title, or anything of that sort. It is the bare cost of the property. It does not include surveys or anything of
6488 that kind. All of these tracts were in the Webber ownership at the time of the purchase, which are indicated on the first line. That is true of the second; the third consisted of two purchases, one tract of 410 acres, and the other from another owner, consisting of 60 acres. These purchase prices of $199,500 in one case, and $14,364.60 in another case, do not represent the entire cost of the properties to the company, as they do not include recording fees, and the searching of title, and the costs of the abstracts of title, or any other minor charges of that sort. It represents the payment made to the owners. I would estimate that all the remaining items, including legal items, and so on, would not exceed $2,000, and would certainly be under $5,000, and
6489 that is based on general familiarity with the books. Charges are numerous; they consist of a lot of small entries for recording fees, and continuation of abstracts of title, and that sort of thing. I am familiar with the books, and would feel safe in saying that that would be the limit. That item alone might possibly add in the neighborhood of 50 cents an acre to that purchase, although I feel quite certain it would not.

6490-6491 In the case of the San Felipe, there was no segregation made as to price. I might say that the reservoir land in this particular case included a considerable portion of the bottom lands in the reservoir, and for that reason it would come above the average price, probably.

Questioned by Master.

It would naturally include some of this $100 land that I speak of.

(The table was offered in evidence, but upon objection by Counsel for Plaintiff, the ruling on admissibility was reserved.)

RE-DIRECT EXAMINATION BY MR. SEARLS. 6492

The land outside the reservoir, with the exception of 2,000 acres in the first tract, is tributary to part of the watershed of the reservoir, and I would say that ownership of lands on the watershed permits of a greater control of the purity of supply, and to that extent has value.

(Discussion among Counsel and the Master as to the method em- 6492-6494
ployed by Mr. Grunsky in order to determine his ratio of ten to one as between watershed and reservoir lands.)

Witness: Geo. L. Dillman for Defendants. 6495

DIRECT EXAMINATION BY MR. SEARLS. Dillman

I have examined a good many reservoir sites, and advised as to the feasibility of utilization, on the Kern River, the Stanislaus River, the Feather River, Pitt River, on Stony Creek, Cache Creek, and on Pewter Creek. I am familiar with the projected and constructed reservoirs, most of them prior to construction—but few of them have been constructed, of course. I am familiar, in a general way, with the elements which an engineer takes into consideration in advising on the economic feasibility of a reservoir site. The cost of a reservoir site, in the first place, is part of the cost of the storage, and is always taken as a consideration; added to the cost of construction, it makes the cost of storage, for large reservoir sites are compared as to the cost per million gallons capacity, or acre foot capacity, or some similar and convertible unit.

This is an estimate of probable cost. I have been rather careless 6496
in using the term ''value'', because value is a matter purely of opinion. There are some matters of fact connected with cost, but small connection oftentimes exists between cost and value. The probable cost of lands for flooding for reservoir purposes is limited to what a jury would allow in condemnation. The cost and value at
time of acquisition are presumably the same, and are stated in the 6497
award. Sometimes, however, the award is too high for the purchaser, and he refuses to proceed. The land sought has not that value to him. I can conceive of the case of a granite bowl of property, shaped for reservoir, having no value for any other purpose, and therefore, the ratio of its value as a reservoir to its value for other purposes would be infinity, irrespective of what that value was. There are also possible cases of physical reservoirs in the heart of a city where the value for residential purposes makes them absolutely prohibitive for reservoir purposes. Between these extremes, my experience is that the value of land for reservoir purposes, as indicated by the cost

of acquiring it for such purposes, very closely approximates its value for other uses.

In the case of the Spring Valley reservoir sites, their maximum values to the original owners was for purposes other than reservoiring, except, possibly, in the case of the San Mateo Waterworks, where the price paid reflects a much greater cost (value) than other lands. I understand that the San Mateo Waterworks purchase included water rights and structures difficult of segregation from the cost of the land.

It follows that the original cost should have been the value for all purposes (possible to the owner) at the time of purchase. The probable cost in 1913 would be measured the same way. Otherwise, the purchase of railroad terminals would be impossible in many cases. The right of eminent domain was extended to avoid just such possible hold-ups. The compilation made by Mr. Bailhache, at my request, from Spring Valley figures, shows this original cost to have been $114.24 per acre for Crystal Springs, $60.43 per acre for San Andres, and $12.13 per acre for Pilarcitos.

6498 If the lands had not been purchased then, but had been recently acquired, the original cost (value) should have increased about as other agricultural lands, say 5% per annum. The reason for using 5% is based on my opinion that real estate investments properly made should yield about 5% to the investor, and while in some cases they do not—and in other cases they yield a great deal more—if a man is assured of 5% on that kind of investment, with that kind of security, it will receive a great consideration by the investing public. It seems to me, moreover, that if the owner is allowed 5% a year appreciation in the value of reservoir lands, in the long run the increase of value of his investment will approximate the increase in value for other classes of real estate investment, and that full justice will be done. With the elapsed time, this increase is as follows:

Crystal Springs,	180%,	1474 acres at $320.......	$471,680
San Andres,	230%,	442 acres at $200.......	$ 88,400
Pilarcitos,	250%,	28 acres at $ 45.......	$ 1,260
			$561,340

If the value of reservoir lands is absorbed in the adjacent properties, as I understand was done by Mr. Smith, at an added value to those lands without presence of the lakes, of $402,182, taking Smith's valuation as correct, this would add to his estimate $159,158.

The difference between the costs of lands for reservoir and pipe line right of way is the damage by severance, the lands for reservoiring being generally purchased in whole pieces.

These purchases are not generally at the lowest market prices for lands, because the purchaser expresses a desire for that particular

farm or piece of land. It is different from a purchase of a piece of land where many in the neighborhood are able to fill the require- 6499
ments. Naturally the owner boosts his price. This is common to all rights of way.

I might say that the purchase of reservoir lands is not different from purchase of other rights of way, it is directly akin to it. It is storage of water instead of storage of cars. In the case of reservoirs whole pieces are taken, so that there is no damage by severance from other property.

An alternative method of valuing Peninsula reservoirs suggests itself if the real estate value of the flooded lands in 1913 should be assumed. When a corporation has acquired the lands of a reservoir site, and built their storage, the matter of entire feasibility is settled. The business is behind one. All doubts are removed. This increases the value to the corporation, which is reflected in the added stability, or increased market price of their securities.

But these increased costs and added values are not enormous in amount. They are not at all uniform. I estimated at about twenty-five percent in the case of Peninsula reservoir lands, and fifteen percent in the Calaveras.

The difficulty in applying this 25% on lands on the Peninsula lies chiefly in the difficulty of ascertaining the real estate value of the lands in the flooded area in 1913. After a casual examination of the figures introduced in this case as showing value of adjoining lands, I have assumed—and it is a pure assumption—that a fair basis for figuring these reservoirs would be about as follows:

Crystal Springs	$250 per acre
San Andres	$175 per acre
Pilarcitos	$ 50 per acre
Calaveras	$ 70 per acre

Applying these percentages as indicated, the total value per acre 6500
of these reservoir sites would be about as follows:

Crystal Springs	$312.50
San Andres	$218.75
Pilarcitos	$ 62.50
Calaveras	$ 80.50

For other suggested reservoirs, such as Arroyo Valle and San Antonio, I add no percentage, because I do not consider their adaptability for reservoir use is established.

It is, of course, understood that these assumptions of basic realty values on my part are purely on the basis of what seemed reasonable to one who is not qualified as a realty expert, and so far as they may be changed by the Court, by so much my reservoir value per acre would be increased or diminished.

There is no such factor as ten to one for reservoir lands in my experience. There seems to be no such ratio in the original cost of the Spring Valley lands. I am quite sure there was not in the Contra Costa purchase. The more recent Peoples Water Co. purchases cannot be gotten. The Crow Canyon, Bollinger Canyon, Las Trampas, and other creeks in those hills were made by Dingee, Haven, and associates; then turned over to the water company with other property at a lump sum, presumably at an advance. While these are stated to be reservoir lands, and some were purchased at a considerable advance over prices of adjacent lands, their value as reservoir lands is not yet proven.

Generally, reservoir lands are purchased together with water rights, which are included in the price paid. In estimating the land values separately, this should be taken into account.

The right to condemn for reservoir or other public service uses limits the cost to what would be allowed by jury in condemnation. The owner is given the maximum value for all purposes. All the purposes that he can use these lands for are other than reservoir pur-
6501 poses, so in the case of the Spring Valley reservoirs the maximum cost that would be allowed, or it would be proper to pay without condemnation, is the maximum value of the lands for grazing, agricultural, residential, and other uses, but does not include any consideration for reservoir purposes.

This right to condemn should not be allowed to operate to the advantage of a public utility company to give them an increased value of ten to one over cost. The right is a public right, and is not granted for the purpose of mulcting the public, but of serving it.

This factor of ten to one for reservoir uses would often condemn a reservoir site on account of excessive cost of storage. The Crystal Springs Reservoir, for instance, would get a comparative cost of storage about as follows (using my values):

1,474 acres land at $320	$ 471,680	
Construction	1,600,000	$2,071,680
68,800 acre feet capacity—which is about right—at $31.12		$2,071,680

An amount which is not out of the way compared with other storage. It is about from two to three times as much as you would expect to pay for big storage in the Sierra Nevadas.

But if the cost of the land were $1,000 per acre, the estimate would be this:

1,474 acres land at $1,000	$1,474,000	
Construction (as before)	1,600,000	$3,074,000
68,800 acre feet capacity at $44.60		$3,074,000

This is such extensive storage that economical consideration would, in my opinion, warrant the abandonment of the project. It is always possible to pay too much for a desirable thing.

In corroboration of the above opinions these facts about known reservoir sites are added:

The reservoir site for Hayward was recently appraised at residential land prices, and nobody in connection with the costs ever men- 6502
tioned any special value in addition for reservoir purposes. I was an appraiser.

Questioned by Mr. McCutchen.

Mr. Dillman: The following is based entirely on what Mr. Haehl said this morning. I am not acquainted personally with these sites.

The Bay Cities Water Co. made purchases of six reservoir sites, varying in cost from $3.68 to $70.20 per acre, the average being $14.55. This information is based on data as to the price paid by the Bay Cities Water Co. for these lands, furnished by Mr. Haehl, chief engineer of the company, and in using his table, I have considered as of very little weight those reservoir sites in which it appears impossible to segregate the cost of the land from the cost of the water rights, rights of way, etc.; I have given the principal weight to the purchasers in fee of lands, portions of which were to be flooded.

The Phoenix Gulch reservoir site of the Marin Water & Power Co. cost $55,000; the improvements were estimated at $15,000, making the land cost nearly $40 per acre, and I think this included some water rights. Information from record in Railroad Commission condemnation case of Marin Waterworks.

The reservoir site for the Town of Livermore has never been estimated at more than agricultural land values. I was one of the appraisers.

Wild Horse Valley Reservoir for Vallejo, Hastings Ranch, 1657 acres, cost $40,000, or $24 per acre. Information from City Clerk of Vallejo.

The land for the City Reservoir at Oakdale was purchased at agricultural land prices, $80 per acre. I was present when the deal 6503
was closed.

The P. G. & E. Co. paid $20,000 for land, water rights, rights of way, power-house site, and other privileges. This was largely timbered land, and does not indicate an abnormal value for reservoir lands for flooding. This was French Creek, $100 per acre. The acreage is a little bit doubtful. It is about 200 acres.

Questioned by Mr. McCutchen.

(Mr. Dillman: French Creek is a tributary of the north fork of the Feather, coming in on the east side of Big Bend. The sale was made by the Truckee Lumber Co., and this information is from the president of that company. The character of the country is a granite

country, timbered. The power-house site is down on the lower bench. It is land with virgin timber on it.)

6504 A few years ago I investigated many storage sites on the Stanislaus River with a view to recommending acquirement, and the highest price asked for land was $25 per acre, and most of the reservoir sites were wholly on government land.

The Lake Arthur reservoir site of the P. G. & E. cost $37 per acre, and included some water rights. Information from Railroad Commission record in a rate case. That was an application by somebody for a reduction of rates on irrigation.

The Gravelly Valley reservoir site of the Snow Mountain Power Co. cost from $10 to $45 per acre. The most expensive piece, 440 acres, cost $20,000. Information from manager of company.

Goose Valley, Shasta County, is a reservoir site of about three times the capacity of Crystal Springs, with a dam only 50 feet high, and was paid for, and is held at agricultural prices.

Questioned by Master.

(Mr. Dillman: By being held at agricultural prices, I mean its value to the present owners, and that they have offered to sell at the present agricultural price. I am the owner of half of it, and my brother-in-law owns the other half.)

Big Valley of the Pitt River, which in capacity contains 60% of the proposed government storage of a few years ago for the Sacra-
6505 mento drainage, has lately been abandoned as such, and the land is open for entry. This is a very large reservoir site, one of the most magnificent reservoir sites in California. In saying it contains 60% of the proposed storage on the Sacramento and tributaries, I knew that the other storages considered, and included in the 40%, were big meadows, which has since been developed by the Great Western Power Co., Indian Valley and Stony Creek, which has since been developed by the government, and Cache Creek, Pewter Creek, and some other smaller storages, and yet this one reservoir was a reservoir of such capacity that it contained 60% of all these proposed storages.

The reason for its abandonment I know only by surmise; its use is too remote to warrant immediate construction. The possible use of water in that part of the valley that that could be used for—other water is available, and in smaller units; this is a very large unit, and could only be considered in connection with a very extensive irrigation of the whole Sacramento Valley. I simply cite that big valley as an instance of a magnificent reservoir site where the other uses were equal to, or superior to its value for reservoir purposes.

In 1902 I was State Engineer of Oregon, and investigated all the Carey land applications, many of which included storage. In no case do I remember of any storage which was held at higher than agricultural, grazing, or timber lands in the immediate vicinity.

The use of Lake Merced for a water supply is a temporary one, and in the very near future it will, in my opinion, be abandoned as such; for that reason I do not consider that it has any special value for reservoir purposes. It has real estate value. 6506

The tables attached to this table purporting to show the original cost of reservoir lands, were compiled by Mr. Bailhache, from the Spring Valley records.

Mr. Searls: In explanation of those tables I will state that there were certain parcels there on which we have been unable to find any data as to the original cost, and nobody in the Spring Valley force seems to know what the original cost was. That includes the large parcel, 5-2, in the Pilarcitos watershed. In-so-far as the actual figures on these parcels are lacking, the averages, of course, are defective.

Questioned by Master.

Mr. Dillman: Referring to the first table, Pilarcitos Reservoir, 6507
item "Total acreage with cost $27.90": That omits the three items above in acreage, for which they have not the cost, and takes in only those that they have the cost of. That means with cost known.

Mr. Searls: The same is true of one parcel in the San Andres. In the Crystal Springs there is a note; "San Mateo Water Co. purchase was not included, as we were unable to segregate the real "estate value from the cost of water rights and structures". The same is true of the million dollar purchase in the Calaveras watershed. That was the purchase of the Vallejo Mills water right from the Alameda Water Co., and included quite an acreage of land, as well as certain structures and water rights.

Questioned by Mr. Greene.

Mr. Dillman: In the first table, opposite Pilarcitos, the item $7550 has been ignored, because it included additional outside rights of way and riparian rights other than on the land that was purchased; and has not been taken into consideration in these figures. 6508

Questioned Mr. Searls:

Mr. Dillman: If these figures of cost are wrong, then by that much my figures will have to stand corrected. That was simply the best evidence we could get as to original cost.

I did not consider the adaptability of the Arroyo Valle and San Antonio reservoir sites for reservoir purposes established, as it is very doubtful, in my opinion, if they will ever be utilized. 6509

CROSS EXAMINATION BY MR. MCCUTCHEN.

Mr. Dillman: By economic feasibility, I mean that I do not think that the reservoirs are worth building for the extension of this waterworks. At present the flow-off is somewhat used through the wells and filter galleries, and the cost is fairly high, considered for this use. The demand for a water supply further off will further increase the probability of their never being utilized, and

altogether I consider their utilization a matter of great remoteness, if not altogether out of the question.

I have not made any definite estimates on what a dam at San Antonio would cost, or how much water could be impounded in that reservoir if it were converted into a reservoir. The same
6510 answer applies to the Arroyo Valle.

I have examined, in the last 20 years, a great many reservoirs, a great many dam sites in connection therewith; these are not specially favorable dam sites, and while they could be built, and a great deal of water stored there, the cost per acre foot of storage, or per million gallons of storage, would be higher than would be warranted. In a general way, I say that simply by comparison with other sites I have estimated on and have made definite figures on, and not from any definite figures I have made on either of those sites. I have been on these sites, and it is by comparison with sites on the Stanislaus, which are just as available for supplying San Francisco and Oakland as Hetch-Hetchy. The comparison, in my mind, is the cost of storage per quantity stored; I have not considered the other sites that I have compared them with in any other connection except as to cost. I do not say that I have
6511 no idea as to what it will cost to convert these sites into reservoirs, but I say I have made no definite figures on them.

My idea is, compared with other reservoir sites, that it would cost from $50 to $75 per acre foot for the Arroyo Valle to convert it into a reservoir. I don't know what the capacity of the dam is, and I do not remember how long the dam would be, and as to its height, that is a matter for future consideration; I do not think it is settled. A water surface would depend on the height of the dam. I have been there 3 or 4 times in the last 10 years, and was there last in 1914 to renew my memory of the location. I think there is more than one dam site on that stream. I know where the proposed Spring Valley Dam is, and where they made the
6512 soundings there exploring the site; I know where that is.

The cost per unit of water stored would be less at Calaveras than it is at Arroyo Valle. I only know how much water could be stored at Calaveras from hearsay. I think that Calaveras is worth developing, but I did not refresh my memory as to the quantity of water which could be stored there before I fixed the value upon Calaveras for reservoir purposes, as I did not consider that important.

I only know what Crystal Springs capacity is from hearsay. That is one of the important elements to be known for the purpose of arriving at the conclusions at which I arrive. That is one
6513 of the two important questions, and in a general way, I did know that when I reached my conclusion. I didn't get the definite figures at Calaveras, although I have seen them. I did not get any figures.

It is not necessary to get those figures for these conclusions. It is important that those two things be known, the cost of construction, and the capacity of the reservoir, in order to determine the cost of the storage per unit stored, and it is that figure—an estimated figure in my mind, which I have given, and I have not gone into further details in connection with either one of these storages.

I do not know now what my estimate was as to the capacity of Calaveras for the purpose of reaching that conclusion. It was not necessary that I should have known that in order that I should reach my conclusion. The thing of importance in any case of that 6514
kind is the ratio of the cost of storage to the amount of storage. If you don't know the amount of storage, or the cost, you do not determine the ratio exactly, but you determine it sufficiently to make that determination. You do not have to go into great details in examining proposed storages to condemn a lot of them. I made, in my mind, a sufficient investigation to condemn these. I did not condemn Calaveras; I have said that Calaveras was probably worth making, and have never criticized the feasibility of its storage. It is not as well worth making as Crystal Springs. I think it is worth making into a reservoir, and I have no doubt about it. I am not certain it is worth converting into a reservoir from definite 6515
figures of cost and capacity. You would have to have those in order to determine whether it is worth making into a reservoir, and if it was my business to settle the question, I certainly should have those figures. I should not have those figures in order to determine whether the property was worth converting into a reservoir or not; if I had the ratio, it would suit me. I think I have it sufficiently close to show what I have said. I suppose the cost of storage there would be from $30 to $40 an acre foot. That is gotten from my experience and the examination of other sites that I have become acquainted with, and on many of which I have made figures. That is all I have to base it on. One of those sites is Gabbitt's Meadows, and Speyer's Meadows on the Stanislaus. Those are reservoir sites.

I had some completed reservoirs in mind when I arrived at these conclusions with reference to the value of these reservoir sites in a general way, but I did not use definite figures. I think 6516
it is correct to say that I based this conclusion of $30 or $40 upon information which I had in other cases, but offhand I cannot tell you what the cases are. My connection with these cases has covered a great many years of work.

I know the Blood Reservoir on the Stanislaus. It sold for a great big price, I was told, but I do not know to whom. I think Jim Bishop was connected with that in some way. I stated in connection with reservoir sites on the Stanislaus that my experience was, they only sold for the value the land had for other pur-

poses. I think the Blood Reservoir was sold for a price that was greatly in excess of that, but it never has been used for a reservoir, and never will be. I believe that the men who bought it were swindled when they bought it for a reservoir site.

The Strawberry site is on the Stanislaus, and is now being developed. That was not sold separately, but was sold with the old Tuolumne Water Co.

6517 I said this morning that I examined reservoir sites on the Stanislaus, and that the prices put on them by the owners who desired to sell them was a maximum of $25 an acre, but there were no sales that I know of. When I was examining the reservoir sites on the Stanislaus, I condemned the Blood Reservoir just as I condemn the San Antonio as being entirely not worth developing.

I do not know how much water can be stored in the San Antonio, but I do not think there is ample water to fill it. I have seen the reservoir sites, and I have seen the run-offs, and do not think it is worth making, because it would cost too much per unit of water stored. I can get the figures as to what the costs will be, but I did not have them when I arrived at these conclusions, and
6518 I did not have them when I condemned the Blood site either.

My criticism of the Blood Reservoir site is that it is not worth developing; it is not worth making a dam for.

I am not prepared to state what the market value was of the land covered by water in Crystal Springs Reservoir on the 31st day of December, 1913. Its use was in connection with so many other
6519 properties that it had no special separate value at that time. There was no market for it. It was not either for sale as a separate piece. It was not available as a separate property, and therefore you cannot speak of the market value of a property of that kind. There was no market, and there was no offering, and if there were no buyers and no offering, it didn't have a market value.

I owned the property that I spoke of in Shasta County on the 31st day of December, 1913. It had a market value on the 31st day of December, 1913. The Crystal Springs Reservoir, on the 31st day of December, 1913, had no value for anything but reser-
6520 voir purposes, and only in connection with the Spring Valley System. It had a value, but I do not know that you could speak of a market value in connection with that, because it could not be separated from any other very valuable property.

These properties of the company are all like a connected chain —I don't mean for strength, but for parts; each link was acquired originally by itself, and together they make a complete chain, and each part is necessary to every other part. At the same time, you cannot consider selling a link out of the chain after the chain has been completed, but you can consider the acquirement or the manufacture, or the forging of each link that goes into that chain,

and that is what I tried to do in the matter of the Crystal Springs Reservoir land. If the dam had not been constructed in 1913, those lands would have had a market value, and they would have been acquired at some price. I don't know any more definitely about what that price would probably be than I have given, $312.50 it figures up, but that is no definite figure; it may be high and it may be low, but after it was developed, and the reservoir was made, then those lands were available for absolutely nothing but reservoir purposes, and I have put that value with the reservoir constructed at about 25% above what it cost. That is because of the proven feasibility of the thing.

I have placed no figure on this property. I have examined the 6521
records, and have noted the appraisal of the lands immediately adjacent to that link; I have assumed, for the purpose of this estimate, a value somewhere below the maximum, and above the minimum of those lands, $250 an acre, which would probably be the cost of acquiring them if there was no reservoir there, by the Spring Valley Company, and I added to that cost price, by reason of the proven feasibility, the absolute killing of all value for anything but reservoir purposes, 25%.

Referring to my memorandum, Crystal Springs 180%, 1474 6522
acres at $320: That is an alternate method of getting at the value. For that figure I have taken the original cost, and increased the value 5% a year, which is fairly high for that sort of return. I have considered the time of average acquirement as being 36 years. That would make the increase 180%, and that is in addition to the $114 per acre, which is shown to be the original cost. That has nothing to do with my other method.

The land in Crystal Springs Reservoir would not be worth $320 an acre on the 31st of December, 1913, if it were stripped of the use to which the Spring Valley were putting it. It was worth that. If the premises are right, the result is right. This paper which I have presented is very largely a matter of opinion. There are a few facts in connection with it. There is some argument showing how I lead up to the results from the premises, so that it is partly opinion, partly argument, and some facts.

Referring to the schedule, under the head of Pilarcitos Reservoir, where I have one tract of land 3.30 acres in the reservoir, total cost $788.50, and the price is put down at $24.93 an acre as of date the 26th of September, 1866: I did not make use of that information in arriving at my result, nor did I make use of the 6523
next figure, 24.10 acres at $10 an acre. The figure that I made use of in that schedule is the average 12.13, and then the date of acquirement. That was a compilation, made by Mr. Bailhache, at my request, from figures supposed to be taken from the Spring Valley records. All that I have used are his conclusions. I do

not know whether these figures are right, but they are not so outrageous that they seem unreasonable, and therefore I have taken them.

I neither made nor used the figures $24.93, $10, and $30.26 for the purpose of arriving at my average of $12.13. I commenced at the $12.13. I considered they were acquired 50 years ago from 1913. It seems to be correct to say that I have taken as the cost of a piece of land in 1866, $12.13, whereas the company actually paid $30.26
6524 for it in 1870. Also I took the cost in 1866 to be $12.13, whereas the company paid $10 for some of it in 1889. I regard that as sufficiently scientific for the purposes of this estimate.

I took the average as $60.43 at San Andres as of 1868. Part of that land was acquired in 1868 at $91, and others at $120. If these figures I have here are incorrect, the $60 is incorrect, but if the $60 is incorrect, I do not think my structure falls; it changes the price. I am allowing in this estimate 5% from the time of acquirement on the price of acquirement, and I think when the annual returns on the rates are considered that 5% is very liberal. At the end of the first year the 5% is only an instrument in the value that I have allowed. You could figure it at compound interest if you wanted to, but it would be a lower rate. I have said that
6525 land increases 5% per annum, but not at a compound rate.

If I bought a piece of land in January, 1867, I should hope it would be worth 5% more on January 1st, 1868. If you figured upon compound interest, you would start with a new principal on January 1, 1869, but this method is just as scientific as to use any compound interest tables, because it is near the probable truth, which is 5% on its original cost. 5% on its value from year to year would not be correct, as it would be too much. If a man deposited his money in a savings bank, he would get interest on interest in that case, but here he is getting more than 5%; he is getting returns on rates right along in addition to the 5%. The 5% is an increment over and above what he gets in water rates.

6526 Questioned by Master.

Assuming that this is grain land, this 5% which I compute on a simple interest curve is the increase in value going along with an assumed return from the property that is otherwise used.

CROSS EXAMINATION BY MR. MCCUTCHEN.

That is absolutely a scientific way of getting at it. I have a good deal of knowledge about the increment of land prices. If land will increase in value on the average 5% per annum, computed at simple interest, it will be better returns than the average farm lands that I am acquainted with, and I am acquainted with a great many farm lands. In this estimate I have considered that these
6527 lands did increase 5% on an average. Land goes up by jumps, and

sometimes goes down, but the curve is generally up, and if you get an average of 5% increase per annum, you are doing pretty well in farm lands or other lands. I do not know as much about town lands as I do about country lands, and I know very little, except from hearsay, about land in San Francisco. Nobody has told me about the rate of increase in value upon the Peninsula, and I do not know of any piece of land on the Peninsula to which my rule can be applied. I think the platted lands, that is the subdivided lands, on the Peninsula, in the locality in which these lands are situated are worth much more than their original cost, plus 5% per annum simple interest. I doubt if the farm lands are worth 5% per annum increase since 1866. These are neither farm lands nor platted lands; they could be farm lands, and if they were not utilized for other purposes, some of them could be platted land.

I have been down below Woodside, but I have not studied the lands of the Peninsula. The lands below Woodside, some of them, no doubt, are worth today a figure very much greater than their original cost, plus 5% per annum. I think there are farm lands in west of these that are not worth any more. I was told that by people 6528
down about Spanish Town.

I recognize that these lands would be available for other purposes if they had not been acquired by the Spring Valley Water Co., and put to the use to which they have been put. They would have been available for farming, grazing, and residential purposes. I have seen a list of the values that Mr. Smith put upon property immediately on the edge of the Crystal Springs lake, but I don't know them now. I think they are somewhat lower than the values I put upon the land in the lake. The figures which I used of Mr. Smith's, the definite figures in this estimate, were the figures he 6529
put on, an increase in the price of adjacent land by reason of the lake being there, and in which he says he absorbed the value of the land under the water. Those figures are not necessary at all in order for me to reach this conclusion. If his figures are wrong, mine are wrong to the extent his are wrong.

When he says he absorbed these values, I do not understand that he put any value at all on the water-covered surface, but he added a value to the adjacent lands by reason of the water being there, and he says that they absorb the value of the land that was submerged, and I took that at its face value, $402,000, and have added to that estimate, I think, $100,000 odd. That is on page 2.

Questioned by Master.

I got the figure of $320 for Crystal Springs by taking $114 as the initial price, and adding 180% to it; that is 180% of $144. I got the $114 from Mr. Bailhache's figures, and then took 180% of that, which gives $320. In the alternative method I do not take 6530
Mr. Smith's valuation and add 25%. I take a larger valuation than

Mr. Smith's. I had a map with a great many valuations on those separate tracts, and while I could not get a weighted average, I assumed, from an inspection of that map, it was about $250 an acre that they had put on as the value of those immediately adjacent lands. I assumed as a fair average, roughly gathered from the testimony of all the witnesses on either side, $250 an acre for the lands bordering on the lake, and therefore, for the lands submerged, and I added 25% for that, because the feasibility had been proven. On page 4 are the prices I assumed to be the average of the prices there. I have no original ideas as to those values. Crystal Springs, $250; San Andres $175; Pilarcitos $50; Calaveras $70, to which I add 25% for the lands on the Peninsula, and 15% for the Calaveras. My method is to adopt $320 an acre for Crystal Springs, $200 for San Andres, $45 for Pilarcitos, and $80 for Calaveras.

CROSS EXAMINATION BY MR. MCCUTCHEN.

6531 I arrive at the 180% in the case of Crystal Springs, 36 years at 5%, or 180%. My principal is $114.24; the result is not carried out exactly. The land covered by water in Crystal Springs Reservoir I say is worth $320 an acre on the 31st of December, 1913, and that was its market value so far as its market value could be obtained.

In this case, market value would be the value at which I would expect to acquire those lands in 1913 if there were no reservoir there, and other conditions were the same as they are now. By market value, that is what I mean, what I have to pay for anything, or what it will sell for if I have it for sale.

I know that in nearly every instance land that was acquired, and subsequently incorporated in the Crystal Springs Reservoir,
6532 was acquired with other lands. That is to say, that as a rule more land was acquired out of the reservoir than in the reservoir. I have not gone into land values outside of the reservoir areas, and I cannot state that every acre of land in the watershed purchased with land in the reservoir is worth $320 an acre. It would make me think that 5% was altogether too high, because I am satisfied that while I am not a land expert, and especially not an expert in this locality, I know that a great deal of that land that is not submerged, in fact very little of it, is worth $320 an acre. I think some of it is worth more than $320 an acre, but the average is worth much less than $320 an acre. I think, when my attention is called to it, that 5% is considerably too high, but as to how much,
6533 would be a matter I would have to make a good many figures on.

If I am to take up this matter of outside lands, I want to go into it very extensively, because I have not done so up to date. I am not going to say that lands outside the reservoir are worth $320 an acre, because I know they are not. I am not trying to reduce this to absolutely definite figures anyway, because the inaccuracy

of the premises, the 5%, do not warrant any fine-cut calculations. In discussing this discrepancy between the land under water and 6534 the lands outside for the increment in prices—5%—I am going to say, if you want the comparison made, that this indicates that 5% is too high rather than that the outside lands are worth $320 per acre.

The outside lands have a market value which is more easily arrived at by appraisal today than the lands under the lake. I have tried to arrive at the value of land under the lake in as reasonable a way as I knew how. There is nothing scientific about this method, or about any method of getting at these values. This is a matter of opinion based on reasonable premises. If my premises are wrong, my conclusion is wrong. I am inclined to think, from the way you put it, that that 5% is too high, but at the same time, these lands have been entirely separated from any possible use except reservoir use; they should be allowed an accretion value at least as great as any of them, and possibly greater, and I have tried to allow that in my 25% allowance in the one estimate, and the 5% per annum in the other. I believe that that figure is sufficiently high to operate with no unfairness to the Spring Valley Company.

Mr. Haehl did not come here to give some figures which I used in part in reaching my conclusions. He did come here and give some figures on purchases of property by the Bay Cities Water Co., and I referred to those figures in my paper. I didn't pay very 6535 much attention to his estimates. I took those figures as one fact among a great many facts in my knowledge.

I do not think that the lands that were in the water line were worth more at the time of purchase than the lands above the water line. If they were a different character of land, they had different values, but the cost at which they could have been acquired at the time would have excluded their value to the Spring Valley for reservoir purposes. I think some of these lands were bought in 6536 very large tracts, a large part of which were rough hill lands, and I think a good deal of these reservoirs were rough, brushy lands, too. The slopes going down there were undoubtedly brushy and steep. I do not know anything about the condition of the land before it was converted into a reservoir. I am told that in the bottom of the valley there were some small farms. I assume that the lands were rough down to that point; that is, to the bottom of the valley.

Assuming that the Bay of San Francisco is a Spring Valley reservoir, and that in order to get a piece of land in that reservoir for an area of 50 acres, it was necessary to buy land on the hillside equivalent in area to 1000 acres, and that the total purchase price was enough to make an average value of $50 an acre, I would say 6537 that the land in the reservoir might be worth more per acre than

the land on the hillside, or on the mountainside, or it might not be worth more per acre. In some cases some reservoirs are bought, and the land for submergence is not worth as much as the hillsides. I do not assume that to be the case here. I assume that the tracts were average value tracts. I don't know but what these lands were anything more than swamp lands, and I assume that the lands in the reservoir were worth no more than the lands on the hillside, and purchased as part of the same transaction.

I say the lands on the hillside are not worth $320 an acre, because I am satisfied that they are not, but that does not lead me to the opinion that the lands in the reservoir are not worth $320 an acre. I assume in these figures that wherever a purchase was made
6538 which included hill lands, and land that subsequently became submerged in Crystal Springs Reservoir, that the lands in the reservoir were of the same value per acre as the lands on the hills. These values are reached in a different way in another portion of this estimate, and I still would think that the lands were probably worth about $300 an acre. Assuming that the lands in the reservoir were worth 50% per acre more than the lands on the hillside, I would check that by the the other method, and reduce my interest, if I were going to make any figures to cover anything of that kind.

As to what percentage the lands in the reservoir bear to the entire purchase in the number of cases I used for the purpose of
6539 arriving at the cost of the lands in the Crystal Springs Reservoir, this record of Mr. Bailhache's would answer that question. The gross acreage is shown here, but it is not summed up. The total acreage of parcels produced, and out of which the 1473 acres were carved, were several thousand. Probably the 8,000 was about 20% of the area included in those areas; the largest one is 2,000 acres. The remainder of the property has been appraised by people who know more about real estate than I do, and I do not know whether I would have appraised it on my basis at very much more than they
6540 did or not.

I don't think that property has increased at the rate of 5% since its purchase. At the same time, in making an estimate of this kind, my figures attempted to be made are outside figures. I won't name any figure at which I think I ought to have calculated the interest, but it should have been something less than 5%. I think $320 is about right, and I have reached that approximate price in a different method, which makes me better satisfied with
6541 it than if I reached it by the single interest method. I have estimated the value of adjacent lands at $250 an acre, and by adjacent lands I mean next to the lake; not a strip 10 feet wide, but the possession of lands, part of which are in the lake, and the estimate has been given by various appraisers immediately adjacent to the lake. I mean by that that if the company purchased a piece of land, 10

acres of which was in the lake, and 2,000 of which was on the hillside, that the value of the 2,000 acres not in the lake, I took from the other appraisals, and I do not know that they are worth $250 an acre. I took it from no definite appraiser, and as to what lands I took it, they were the lands adjacent to the lake on which appraisals had been given. I think the names of the appraisers were Baldwin, Hoag and Smith. I took their various valuations, and struck an average. I considered that to get a weighted average, if I could, but I could not do it. That is simply from sizing up the values put on around that lake, and that would run about $250. I think it will run a little less. 6543

I add 25% to the values which I arrive at for the purpose of getting the reservoir value, because I thought something should be allowed. The land is absolutely taken away from any other possible use, and dedicated forever to reservoir use. The feasibility of storage is entirely settled, the dam is built, and the safety of the reservoir is assured. I thought it should have some addition. I think the 25% is enough, and ample, to cover all these things, because this is an estimate of probable cost, and the acquirement of those same lands might be a little bit higher in value for other purposes if it were done over again, and no wrong was done the company by adding the 25%, and I don't think much wrong was done the community by adding the 25%. I think it is a very fair proposition, and I cannot give any more reasons for my taking the 25% than that. If I thought the lands had cost approximately twice as much to reacquire them, I would have added 100%.

I have an opinion on how much it would cost to reacquire them, because I have been connected with the acquirement of a great many similar lands and rights of way for various purposes, and this is simply a right of way proposition. I have never bought lands for a reservoir, except the one I was connected with in Shasta County, and it was known to be a possible reservoir site at the time I bought it.

I have heard of the case of Spring Valley Water Co. vs. Drinkhouse in this case. That was a condemnation proceeding to acquire 6544
a part of this very reservoir. I did not make any inquiries to ascertain what the views of the jurors as pronounced in that case were. I do know that in that case the jury returned a verdict for a figure very, very much larger than my figure here, but that did not weigh with me at all in this case, because I presumed the acquirement would be done before the construction was done. It is my general understanding that the Drinkhouse condemnation was not settled for a long time afterwards; that they had to have it in a hurry, and settled the case before they could go ahead with the construction. I don't know the history of that Drinkhouse case, and have not studied it at all.

I did not hear of the Howard purchase down there, and did
not make any inquiry about it. I have concluded that these lands
could be acquired for 25% more than the appraised value of them,
6545 and I am enabled to determine that because I have been connected
with the acquirement of a great many rights of way, and railroads,
etc. The acquisition of a reservoir site is more comparable to the
acquisition of terminal grounds, where you buy whole tracts instead
of buying strips through tracts and cutting them up. I recognize
that nature has played a part in providing sites for reservoirs, and
she has played somewhat of a part in providing sites for terminals.
A terminal can be located in the usual and ordinary location, and
that is true of a reservoir site. There are usually particular reser-
voirs for a particular case. I don't think there is a reservoir site
on the Peninsula that is as good as Crystal Springs, or one to com-
pare with the Crystal Springs Reservoir. I do not know of any
reservoir site, and that plays a part in determining the desirability
of locating the reservoir there, but does not, necessarily, play any
part in determining its value. In my opinion, it does not play more
than the 25% I have added, and I allowed that 25% because in
6546 my experience 25% has been enough to allow in the acquisition of
rights of way and terminals for railroads. That is the only reason,
and is a sufficient reason.

I think in this case this land is more available for reservoir
purposes than any other purpose, or rather, it is more useful for
reservoir purposes than other purposes, and I have allowed for that
usefulness and value 25%, because I thought that was enough. I
stated a few moments ago that railroad rights of way and railroad
terminals were my guide. In the case of the railroad right of way
and the railroad terminal, they were more valuable and more useful
for those purposes than they were for other purposes. The Third
and Townsend Streets Depot is more valuable for a railroad depot
than for other purposes, because of its proximity to a great city.
If the block just north of it were used, it would be a part of the
terminal. It is the use that makes it valuable, but that is founded
6547 on original availability. All of that flat land there, and all of
those blocks in that locality, could have been acquired for that
purpose. I do not say that this particular block was worth more
than the other blocks before any of them were used for the purpose.

It was only after this property in San Mateo County was used
for reservoir purposes that it became worth 25% more. It was the
use of this property for a reservoir that made it worth 25% more,
which use depended upon its availability, and up to the time it was
used for a reservoir it was not worth 25% more. It was not worth
6548 more than the adjoining land for farming purposes. The 25% is
added because of its proven availability and use, and aside from
that it was not worth any more up to the time that it was actually

made into a reservoir than the land about it, but its availability for a reservoir gave it an added value for reservoir purposes, but it did not increase its probable cost. None of that 25% should have been added to the probable cost before the dam was built because of its availability for reservoir purposes; a part of it at the time of the complete acquisition, and the balance of it at the time the dam was built and the success of the project was assured, so that the timid investor had no further qualms about the investment. Up to the time of its acquirement this property did not have any value because of its availability for reservoir purposes. If it was in one holding, a part of the 25% had accrued, but how much of it I don't know. It was the assembling of it under one ownership 6549
that made it worth more, and the availability preceded the assembling of it.

It was not as useful for reservoir purposes when it was in a dozen ownerships as when it was assembled under one ownership. It became possible only when it was acquired under one ownership for reservoir purposes, and not before that. When it was acquired under one ownership it took on this additional value to the extent of a part of the 25%, and it took on the remainder of the 25% in value when the dam was built. I cannot tell you how much of it was taken on when it was acquired under one ownership. There is no need to split it up that much.

I am not here to discuss the law point in connection with this reservoir, but Mr. Drinkhouse's land would not have been available for reservoir purposes if it had not been connected with some other 6550
land, and therefore I think it would have been perfectly proper to have excluded any special value for reservoir purposes in that condemnation suit, and I think that is usually done in condemnation suits. I don't think that Mr. Drinkhouse was entitled to have taken into consideration in that case the fact that this land with other land would have been useful for reservoir purposes. I think that should have been excluded, and I proceeded on that theory in arriving at my values, except to the extent of 25%. I think I did that in my $320 an acre illustration. When you are figuring 180%, 25% is very easily absorbed.

If I were the engineer for the City and County of San Francisco, and the property were not used today for reservoir purposes, 6551
and assuming that it could be disposed of at the rate of $320 per acre, I would not advise abandoning the reservoir for $320 an acre. Assuming there was no dam there, and that it had been acquired by San Francisco, or some public service corporation that was supplying, or intending to supply San Francisco, I do not think it would be good judgment to dispose of it at $320 an acre, because it is a link in a chain of properties to supply water to San Francisco, that not only gives added value of itself, but increases the

value of the other links in that chain. Assuming that it had been acquired, but not converted into a reservoir, and the city could get $320 an acre for it, and the question arose whether the city should sell it for $320 an acre, or should build a dam and convert it into a reservoir, and it called on me for an expression of an opinion as to whether they should let it go at $320 an acre, I would advise them to keep it.

Questioned by Mr. Searls.

If they could get $100,000 an acre for it, I would advise them to let it go, as it is not worth anything like that.

CROSS EXAMINATION BY MR. MCCUTCHEN.

Supposing that the property belonged to Mr. Metcalf, and there were no dam there, and the City came to me and said they wanted and needed that property for a reservoir site, reservoir sites on the Peninsula being scarce, and they wanted to know from me what I could afford to pay for it, I would have to think it over quite awhile before I answered, but if it was in one holding like that, I should say to the City, start a condemnation suit at once; we will talk about values after awhile. In that case, it being all in one holding, I would expect to pay somewhere between the appraised value of the land and 25% increase. I would try to get it down as low as possible, but as to what I would expect to pay, I don't know.

I have heard of Judge Farrington's decision, and that he put
6553 a value of $1,000 an acre on the land, and that he found it to be
6554 worth $1,000 an acre. I do not know that the City of San Francisco, through its Board of Public Works, made a report to the Board of Supervisors year after year for many years, in which it was stated that this reservoir land was worth $1,000 an acre.

I know that the Turlock and Modesto Districts have acquired a couple of reservoir sites along their ditches, but I do not know what they paid for them compared with the value of lands for agricultural purpose. They should not have paid any more than the agricultural value, but I do not know whether they did or not.

6554½ The Livermore Reservoir is a small reservoir at the top of the hill.

Questioned by Master.

It is not the one in the Mocho. That is only a diverting dam 3 feet high.

CROSS EXAMINATION BY MR. MCCUTCHEN.

6555 The Livermore Reservoir is simply a location for a concrete reservoir; it is only a location for a reservoir. I think 500,000 or 600,000 gallons of water is impounded in it. I do not know what was paid for that, and have never been told. I made an estimate on it for

purchase by Mr. Bissell, and for its sale to the P. G. & E. I simply cited it in this report as one of the cases of a reservoir site that I know about. In the sale to Bissell, and the sale to the P. G. & E. it was not estimated at more than agricultural land values. I don't remember the figure in the sale to Bissell, but it was agricultural land value. I do not remember what it was estimated at in the sale to the P. G. & E., but I do know it was not estimated at more than its value for agricultural purposes, because I made the estimate, and the basis for making the estimate was agricultural land. I know the value of agricultural land. I think my report is in writing, and I made it for W. A. Bissell, both when he bought it, and when he sold it.

I have not a personal acquaintance with the Wild Horse Valley
Reservoir for Vallejo. I got that from the City Clerk of Vallejo. 6556
I do not know what the value of land was for agricultural purposes. I do not know anything about it. The special purtenance of that was to show that the value of reservoir sites was not 10 to 1 as compared with agricultural land. That was the principal purpose of that.

The Oakdale Reservoir site was a piece of land, I think, of about 10 acres, located about ¾ of a mile north of Oakdale. It is peculiarly available for reservoir purposes. There was a 50-foot dam there, I think. It was a concrete dam after it was built. Before it was built it was a hill. It was the crest of the hill. There was built a rein-
forced concrete reservoir on top of it. I built it. Previously the 6557
land was used for farming. It was a grain ranch prior to that time, and it has since become an alfalfa and tree ranch. It was above the system of the Oakdale Irrigation District, and was subject to irrigation by pumps from the ditch. Adjacent land above the ditch has been sold for more than $80 an acre for agricultural purposes, and $80 an acre is not an unfair price for agricultural land above the ditch. I think that some of the land below the ditch was sold for $125. This $80 land was not planted to alfalfa at the time; neither was the $125 land. You can't buy plenty of land below that planted to alfalfa. You can buy plenty of land below that ditch, not planted
to alfalfa for $75 an acre. The lay of the land is better than this, 6558
but the quality is not as good as this. I suppose the maximum height to which they had to lift the water in order to get it upon this land was about 30 or 40 feet, maybe.

NINETY-FIRST HEARING. FEBRUARY 4, 1916.

Witnesses: GEO. L. DILLMAN for Defendants.
J. B. LIPPINCOTT for Plaintiff.

6559-6560 (Certain corrections noted in the transcript.)

Dillman

CROSS EXAMINATION BY MR. MCCUTCHEN.

On page 6512, in answer to the question as to the cost of Calaveras, the eighth line from the top, the answer should be ''The cost ''per unit of water stored would be less at Calaveras than at Arroyo Valle'', instead of ''more''. I am satisfied that that is the fact. The cost of the Arroyo Valle is high, and I condemn it for the reason that the demand for Sierra Nevada water makes it less desirable, and I do not think it is a very favorable site for storage. I do not remember any other reason assigned by me when I was preparing my
6561 paper on these reservoir values.

I think I saw a statement that the City and County of San Francisco, through its engineering representative, declared that San Antonio should be availed of as a reservoir for San Francisco. My condemnation of it simply extends to my refusal to add any added value for reservoir purposes to that land, and that is the result of my condemnation of it, and is not the reason for the condemnation. The result of my condemnation is that no added value should be given to that property for reservoir purposes. The reason for the condemnation is because of my opinion that it is not a desirable site for storage.

I have never made an estimate of cost of the development of a reservoir at San Antonio, and I have never seen an estimate made by anybody else. From a visual examination of the reservoir site—no surveys—and by comparison with other sites which I have had, and made figures on in the past, and my general knowledge of such storages, it is not a sufficiently desirable site to warrant its development. One of the reservoirs, a knowledge of which induced me to
6562 condemn San Antonio as a reservoir site, was Speyer's Meadows. The cost per unit of storage there is very much less than it will be at San Antonio. I think it will be between $10 and $15 per acre foot. That is a reservoir that has not yet been built. I have no figures in my head with reference to reservoirs that exist, and with reference to which I have had experience, but I will look up definite figures. I have never built a big storage reservoir. I don't remember the estimated cost of a dam at Speyer's Meadows, nor the quantity of water that would be impounded there. The estimate of the cost of a dam there of $10 or $15 is not my own estimate, it is Mr. McCurdy's estimate. I don't know that he has ever built a dam. Mr. McCurdy had a plan which I have seen, and I presume it was sufficiently com-

plete to base that estimate upon. It would not be complete enough, 6563
in my opinion, to let a contract. It was a profile and some cross-sections, one anyway. I do not think any soundings had been made at the dam site. The basis of comparison is not that I condemn this San Antonio dam site upon comparison of it with the cost of building a dam at Speyer's Meadows. The basis of comparison is my knowledge that the site at San Antonio is very much wider than at Speyer's Meadows, and at Speyer's Meadows the granite is very close to the surface. I have been there and seen it, and additional soundings are not necessary to make a reasonably close estimate of the cost. They are more necessary at San Antonio, and I presume have been made, although I do not know what the result was in the making of them. It would be necessary to know them in order to get at a detail estimate of the cost of the dam, but it would be less necessary in order to get at the detail estimate of the cost of a dam at Speyer's Meadows. I know there would be very little excavation at Speyer's Meadows for the foundation of the dam, as compared with what would probably 6564
be necessary at San Antonio. I know that from an inspection of the ground. The bedrock is every evident at Speyers. I don't think I have seen it all the way across, but I have seen it so close that very little stripping is necessary. I think the removal of some rock is necessary after the stripping shall have been done.

Speyer's Meadows is 80 miles from the railway station. I would build a cheaper dam there than the one suggested by Mr. McCurdy. I should build either a rock-filled dam with a masonry face, a rubble face, or a dry masonry dam with a rubble face. I have not made any detail estimate of the cost of either of them, but they would cost less than a million dollars. I don't remember the cost of the dam for which Mr. McCurdy produced a plan, but I can get those figures. I cannot tell you offhand the cost of any dam that has ever been constructed. At the time I condemned San Antonio as a reservoir site, I did not have the cost of any special dam in my mind. I only 6565
had the general knowledge that that is not a specially favorable reservoir site, and that general knowledge is as to the width of the valley at the dam site as compared with the width of the reservoir above. The width at the dam site is much greater than at Speyer's Meadows, or at most of the other dam sites.

A dam at San Antonio would cost, for the capacity of water stored, as much as a dam at Speyer's Meadows. Whether it would cost more depends entirely on the height to which it was built, and I think it would cost more at San Antonio if you were to build them the same height at each place. My recollection is that the estimate of the cost of a dam at Speyer's Meadows was less than a million dollars.

Mr. McCutchen. Q. Now, Mr. Dillman, can't you give us some experience that comes a little closer to reality than that estimate on

Speyer's Meadows Dam, that has never been built, and may never be built?

A. Neither has the dam at San Antonio been built, and it may never be built.

Q. You consider that an answer to the question, do you?

6566 A. Yes.

CROSS EXAMINATION BY MR. McCUTCHEN.

Mr. Dillman. I have seen a great many dams, and have had the estimates of a great many dams, and my condemnation at San Antonio is not based on definite figures, nor is it an absolute condemnation, but it is a sufficient condemnation to say that I do not consider anything could be added to the cost of the reservoir lands at San Antonio by reason of its being a desirable reservoir site. A great many reservoirs are built, and never pay for themselves. The Utica Company has built a few of them in the mountains that never should have been built, and that will never pay returns on the investment. Because these reservoirs are built is no reason that they are good investments, or that they ever should have been built. The San Antonio is a case where it may be built, but in my opinion, never should be built, because it would be a poor investment. If the San Antonio could be converted into a reservoir, and the water delivered from it at a materially smaller cost than from Calaveras, and I believed it, it would change my opinion, granting that the estimate was correct.

6567 If it were so that a dam could be built at Arroyo Valle so that water could be impounded there at a cost not more than 75% than the cost at Calaveras per unit of storage, I would change my opinion about the value of Arroyo Valle as a reservoir site. I don't believe that it is so. I have an idea that it is not so just from an examination of the site, and my judgment is not always correct, but notwithstanding the fact that it may be incorrect, and that I have made no investigation to ascertain whether it is correct, I condemn the Arroyo Valle as a reservoir site.

6568 When I said that a great many dams have been built that never should have been built, it carries with it a reflection on the engineer who built them, but it was not necessarily intended to. If the Engineering Department of San Francisco recommended the utilization of San Antonio as a reservoir site, I would want to know who made the estimate, and how it was made, and I would want to know a good many things before I accepted the judgment of the Engineering Department of San Francisco, or of any other engineering department, or engineer. I think that San Francisco, through its Engineering Department, has spoken on that subject, but I would want to examine
6569 those estimates before I would accept any statement of that kind.

I don't know just what the recommendation of the City and County of San Francisco, through its Engineering Department was, as regards the use of San Antonio as a reservoir. I do not know that Mr. O'Shaughnessy made substantially the same recommendation as Mr. Freeman made in his report. I have not gone into the details of the estimate made by the engineer of the City of San Francisco, wherein was recommended the utilization of San Antonio as a reservoir, but nevertheless, I have condemned it in a general way. There is not anything especially scientific about it, and scientific is not the word to apply to this sort of thing. The thing that condemns it is sufficient knowledge of the cost of that storage to warrant my excluding it from any advance in price for reservoir purposes, and that is 6570
the only thing I have done in this case, and it is the only thing I intend to do in this case until I am asked to go into other elements of the case. I will not put an upper and a lower limit on the cost of converting San Antonio into a reservoir without further examination. I had not made that examination when I made the condemnation of it, as it was not necessary, because in my opinion, from a visual inspection, the cost of storage per unit stored would be fairly high in San Antonio, and higher than would warrant its development, and I therefore added nothing for the cost of the reservoir lands for that purpose. The term "rather high" is an indefinite term, but it is higher than the cost of storage at Calaveras, for instance. I don't know exactly what the cost of storage at Calaveras is, but I think it would cost somewhere between $30 and $40 an acre foot. Possibly I may have said yesterday between $40 and $50, but these are merely approximate figures which have no reliability in detail. I would not say that anything over $40 was a prohibitive figure, but $100 would be prohibitive, and in some cases $50 would be prohibitive. For instance, it would be prohibitive for storage for irrigation purposes, but it would not always be prohibitive for domestic pur- 6571
poses.

If storage were necessary, and $50 or $100 was the cheapest that could be gotten, that would be the storage to make. Storage is not prohibitive in the Peninsula reservoirs at what the property there is actually worth, and I would not say that it was prohibitive at $50, but I would not say that it was quite cheap, either. I should study the matter in each case, and decide each case for itself; I would not decide it in a general way at all.

The statement in my paper; "68,800 feet capacity at $44.60; "this is such expensive storage that economical consideration would, in "my opinion, warrant the abandonment of the project", seems to be a contradiction. I presume my opinion at that time was that it would be pretty high; at the same time, these matters are relative, and there are cases where storage costs considerably more than $50, and yet it is advisable to make it. The storage on the Stanislaus

that would be prohibitive to make would be at Donald's Flat. It would be prohibitive for the irrigation district, because it would cost more than it is worth. That is what I mean by prohibitive. That reservoir has not been built.

6572 The Relief Reservoir on the Stanislaus, which belongs to the Sierra & San Francisco Power Co., cost more than $50 per acre foot. That cost was not prohibitive. It was built, but it should not have been built, as it was not a good investment for them. In most of the small reservoirs for cities, and I am speaking now of both storage reservoirs and distributing reservoirs, the cost is more than $50. The Haywards, Livermore and Oakdale reservoirs will cost more than $50 per acre foot of storage.

The $44.60 for Crystal Springs is pretty high. I think I would have stopped there at the time it was built, as it is probably about the limit of what would be the cost of storage for San Francisco. I rather think I would revise my opinion to the extent of saying it is hardly prohibitive, but it would be very high for domestic purposes.

I have read reports about the cost of storage per unit in reser-
6573 voirs in the East, but I know nothing about them in detail. I have never read that the cost per unit, which is the unit that I employ here, frequently reached over $300. The necessities of the case there are much greater than they are here. New York and Boston have to pay a great deal for their water. The necessities for storage in the East are different than they are in California; the necessities in the East are for quantity, and the necessities here are for time. The distinction between quantity and time is that the storage in the East is used up in greater quantity in a short time, and here it is used up in less quantity, but in a longer time Storage is absolutely necessary in both cases, but it is not as necessary in the East, so far as time goes, but as far as quantity goes, it is. There is not as much storage
6574 required to develop a given quantity of water in a given period in the East as is required here, but apparently the necessities of the case are greater in the East than they are here as applied to reservoirs, from the fact that storage has been pretty expensive in the East; they would not have been if there had been cheaper storage there. If they had the same available sites for storage in the East, the storage there would cost no more than it has here; the availability of storage sites is not as great as it is here. That is to say, there are not as many storage sites, possibly, in the vicinity of any one great demand. In the case of the Boston storage, they had to condemn some very valuable property to make the storage that was necessary for the Metropolitan Water Supply, and that made the storage very high there; at the same time, it was a matter of necessity.

If you were to suppose that the Spring Valley Water Co. had not acquired these reservoir sites on the Peninsula, but they had been improved for homes and farms, it would not necessarily have been

necessary, although it would have been desirable, to have acquired those properties for reservoir purposes. The substitute would have been some sites farther away, possibly in the Mount Diablo Hills. They would not be as good as these, but they could be made safe. I would not recommend that for San Francisco if I could get the site of Crystal Springs. Crystal Springs to the water system is 6575
worth a large amount of money, but this estimate is an estimate of probable cost, and I am considering the acquisition of Crystal Springs not as in an inhabited country covered with costly homes, but as open land, or as it exists now, practically, without the construction of the dam. When I say that Crystal Springs as a part of this system is worth a great deal of money, I mean that I would not separate it from the system for a great deal more money than I have put upon it.

There is very little connection between cost and value, except 6576
at the time of acquisition, and sometimes very little then. I have made value equal to probable cost in my discussion and thoughts of this property, but that is simply because I am proposing to acquire these lands as of recent date, and to acquire them as reasonably as they can be acquired, either by purchase or condemnation. I do not know what they can be acquired for by condemnation, except in this way that I have stated. Except at the time of purchase, I draw a very wide distinction between cost and value, and by "except at the time of purchase" I mean when these lands were actually acquired, 1868 and 1875, that I think cost and value may have been the same thing then. The value of Crystal Springs to the Spring Valley Water Co. is very much greater than the cost. If the Spring Valley had not owned the Crystal Springs Reservoir on the 31st of December, 1913, but had desired to acquire it, it would not have been worth more at that time than the figure I have put upon it if the land were in its present condition, because the estimate of real estate values I have accepted as being about right, and that is the estimate I gather from the testimony in this case. 6577

I assume that the land at that time was under separate ownership. If it had been in one ownership, and I had owned it, and the Spring Valley had needed it in its business, I think it would have been worth more to the company, and it probably would have been worth less to me, and therefore I would expect to get some of that difference in the trade. In connection with the waterworks that needed it, it would have been worth more for water supply purposes than the figure I have put upon it. If the City of San Francisco had needed it at that time for a reservoir, it would have been worth just as much to the City of San Francisco if they owned their own waterworks as it is to the Spring Valley Water Co. Speaking of value to the waterworks, that leads to the conclusion that this land has a very great value for reservoir purposes. When I say 6578

to the waterworks, I mean to anybody who would use it for waterworks supply. The value is greater to the person who would use it for water supply purposes than it would be for residential or agricultural purposes; I don't know how much greater. If by value you mean the price at which they would be willing to alienate it, it might be worth more than 100% more, and by that I mean its value in connection with the other property of the waterworks might easily be in excess of 100% of the value it would have for any other purpose.

6579 The accretion in value is gradual, and the necessity for that storage now being full and complete, its value to the waterworks has reached its full amount today, and had in 1913. In connection with the other plant, that may have been 100% more, or in excess of its value for agricultural and residential purposes. It would have been worth the same thing to the City of San Francisco if it had acquired it, or to any other person or party who could put it to the same use. It is more valuable for its special use than it is for the use of any other municipality, or prospective use.

I think, referring to the purchase of land at Oakdale, that that land for agricultural purposes was worth \$80 an acre. I don't know
6580 whether land about it was held at \$80 an acre, but I think the land immediately west of it was held at more than that, which land is under the ditch after it crosses the ditch, and the land south of it under the ditch was sold for more than that. I can't think of the sale of any land in that locality above the ditch at \$80 an acre except this one piece. There is a piece of land similar to this in character 2 miles east of it, 80 acres, that was sold at \$80 an acre; part of it was under the ditch and part of it above the ditch; there was no segregation of the land, but this land being further from town would be worth less, and being partly under the ditch would be worth more. That piece is known as the Patterson 80. There was no counsel that represented the district in that transaction. They did the business without any attorneys, and the City Trustee that bought it was A. L. Gilbert. I don't think that the general understanding there was that more was being paid for that land than it was worth for agricultural purposes, although I did hear that suggestion. I have
6581 heard it suggested in Oakdale that they paid pretty nearly twice as much as it was worth; that opinion was refuted by others, who said that it was a fair price.

I state that it was sold at its agricultural value from my knowledge of prices at which lands have sold in that community. I bought some land of a similar character in a different direction from Oakdale for \$70 an acre before the success of the irrigation was assured. I don't think it was as good land as this. Part of it is above, and part below the ditch, and I knew it would not all be under the ditch when I made the purchase, although I think the inducement was that

the land would, in large part, be under the ditch. I don't think my land is quite as good as this, and its market value is not greater.

The value of land for reservoir purposes to a company acquiring it is always greater than its cost or they would not buy it. I 6582
gave this subject careful consideration before I wrote this. I commenced to consider this matter a good many months ago, at the suggestion of Mr. Steinhart, and then I dropped the matter and took it up again a month ago with Mr. Searls. Before I wrote this paper I had considered the subject sufficiently, and I am now satisfied with my consideration of it, and it is not necessary, in my opinion, for me to give it any further consideration to enable me to express such opinions as I might want to express upon it, unless I get some new data or some new reasons.

I have had experience beyond this Oakdale transaction. There is the case of my ranch in Shasta County, which has been thought particularly valuable for reservoir purposes. I did not buy it for 6583
reservoir purposes, but the purchase of it has been discussed for reservoir purposes, and it is simply a possibility. These two transactions, Oakdale, and my ranch in Shasta County, are the only ones that I happen to think of now that have come within my personal knowledge that enable me to tell the cost of acquiring land for reservoir purposes. I do not consider that that is all my experience and 6584
knowledge as to reservoir lands. I have been connected with businesses in which these questions have been discussed, and values have been considered. I have been with the business of general construction work. At the time I wrote this paper I did not have definite cases of reservoirs, the cost of the acquisition of which I knew, but I had the knowledge of values, cost values, and cost prices, that have been discussed in connection with other reservoir sites. I don't want to say offhand just what they were. My knowledge has not come entirely from definite cases.

My notion is that the statement that land for reservoir purposes is worth ten times its value, or might be worth ten times its value, for other uses, is absolutely unsound and unreliable. The value to a corporation acquiring them could very readily in some cases be 6585
ten times the cost of acquiring them. I have had a good deal of experience in acquiring rights of way, and other rights, for public service corporations, and I have heard of the case of Boone Co. vs. Patterson, but do not know what the facts in the case were. I do not know that in that case land which was held to be worth \$300 for agricultural purposes was found to be worth \$9,000 for boom purposes.

If in case of condemnation of the Spring Valley lands the 6586
owner was entitled to set up a special value for reservoir purposes in case of condemnation, and that was considered, I can understand how, in the case of Spring Valley, these lands might be worth 10

to 1 to the original owner. This is purely a cost analysis, and analysis of probable cost, and its value to the water company was not taken into consideration, but I have added 25% to that value, and that is
6587 the way I have taken it into consideration. The property was not worth that to the man who had it, and from whom the company was proposing to take it, because he could not utiltize it, or make use of it as a reservoir. To anyone who could make use of it, it might have been worth that 100% in his own ownership. I would state positively that I would not alienate it for twice that value. If I owned it, and it was a reservoir site that I could utilize, I would not sell it for twice that.

I do not know that San Francisco is in the market for reservoir sites. I do know that San Francisco, as part of its Hetch-Hetchy plans, has made announcements that it is going to get the Belmont Reservoir, and that the only logical thing for it to do was to get the Peninsula reservoirs of the Spring Valley Water Co.

When I say that it was worth probably 100% more to the Spring Valley Water Co., I mean that it would have been worth that 100%
6588 more to anybody who could utilize it for water supply purposes for the City of San Francisco. It does not make any difference who owns the works, it is a very valuable property. It might be very much more than 100% in excess. I think this land is more useful for reservoir purposes than for any other purposes, and I would also say that that is true of Calaveras.

I drew a parallel between the acquisition of this property for reservoir purposes, and the acquisition of properties for rights of way, and terminal facilities for railroads; they are both for the transportation business, and each of them, practically, a right of way proposition. I said in that connection, referring to these particular lands, "It is different from the purchase of a piece of land where "many in the neighborhood are able to fill the requirements", and I also said "To that extent, then, there is an added element of value "here which would not exist in a case of railroad rights of way and "railroad terminal facilities." With reference to the last statement, the same thing exists in connection with railroad rights of way and terminal facilities. When I said it is different from a piece of land where many in the neighborhood are able to fill the requirement, I
6589 put an emphasis on the "a". Here are special lands which will do for reservoir purposes, and are necessary if the dam is to be built to a certain height, so that the use is a special use, and the requirement is for this special piece of land, not a piece of land which is above the flood line, or a dozen pieces, one of which might be selected for some other use. Your requirement of this special piece of land warrants the owner in boosting his price. That is the reason for an added cost for this right of way, or a railroad right of way, or terminal ground, or anything in connection with rights of way.

In the following statement, from page 3, I mean just what I said "An alternative method of valuing Peninsular reservoirs suggests "itself if the real estate value of the flooded lands in 1913 should be "assumed. When a corporation has acquired the lands of a reser-"voir site, and built their storage, the matter of entire feasibility "is settled. The business is behind one. All doubts are removed. "This increases the value to the corporation which is reflected in the "added stability or increased market price of their securities." I have considered that this accretion of 25% was part of it on the assemblage of the land in one ownership, and part of it on the construction of the work, and the demonstration of the feasibility 6590
of storage.

I don't know what it costs to acquire these lands, except from this compilation. I have not added any overhead or expense for assembling the properties, though I did not assume that that was done without expense. I assume there will be an added overhead expense to this estimate just as there will be to other estimates I have made. If the overhead is applied to the original cost, the result is exactly the same as if the percentage is applied to the overhead on the final price, and I think there is no doubt as to the soundness of that. I don't know what percentage of overhead I would have to add at this time to compensate for that. Whatever it is, it is the same whether it is applied to the original price or the final price. I have not given it any thought as to what rate of interest the earlier purchaser on the Peninsula should have had to have enabled him to have compounded his interest from year to year.

Mr. McCutchen. Q. You say it would not be correct to com- 6591
pound the interest at 5%? A. This is not a return on the investment annually; this is an increment in value which I have considered.

Q. It is the same thing, isn't it? A. No, sir.

Mr. Dillman: I think very likely that my method of adding 5% simple interest would mean only about 1 2-3% per annum compounded. This land has been bringing in returns to the owner. I don't know whether land down about Mayfield or Palo Alto has, or has not, enhanced in value more than 1 2-3% per annum compounded since 1868. Very few farm lands have enhanced in value more than 5% per annum, computing it as simple interest since 1868. I don't 6592
know why this should be an exception.

I am not an expert on the lands on the Peninsula. I have not made myself familiar with them at all. I have taken the valuation as put in here by these real estate men.

My figure of 5% is a pure assumption, and was made with the belief that it was sufficiently high to be fair to the company, and not unfair to the rate-paying public. I have never heard of the value of a piece of property being ascertained in that way; the value of property is generally reached by appraisal, barter and sale. It

may be very unfair to the company, although in my opinion it is not; if my premises are wrong, my conclusions are wrong.

I don't know, of my own knowledge, whether Crystal Springs reservoir land is worth more per acre for reservoir purposes than San Andres is worth per acre. I think it is, because the storage is cheaper per unit of storage. I don't remember now that I know that, but I assumed that to be true; the land is better for residential
6593 purposes if it were abandoned for storage. These values have been values put on by the real estate appraisers, and not by myself, and I have simply accepted them as correct. It is my opinion that the Crystal Springs reservoir lands are worth more acre for acre than San Andres reservoir lands, but that opinion is based in large part on these real estate appraisals. I have an opinion independently of the real estate appraisals, and it is that the Crystal Springs lands are more valuable. How much more, I do not know.

San Andres is higher than Crystal Springs, and is a different sort of a reservoir. It is higher and is better for distribution, but is not of as great capacity, and is, therefore, less valuable for actual storage. Calaveras would not be worth more than Crystal Springs
6594 acre for acre for the same reason; the extra height there is needed to overcome the friction in the pipes to get it to the same elevation. I don't think that storage is much better than Crystal Springs on account of its height. There is not a great difference. I think they are just about the same. It is not as valuable, so far as distribution goes, as San Andres. The reservoir land in Calaveras, acre for acre, is not worth as much as the reservoir land in Crystal Springs, acre for acre. That extra elevation is needed to overcome friction in the pipe to Crystal Springs, approximately; the value to the corporation may be as great as it is in the Crystal Springs, but the probable cost of acquirement of Calaveras is very much less on account of its location, its remoteness.

I do not say that the San Andres reservoir lands are worth acre for acre less than the reservoir lands in Crystal Springs to the Spring Valley Water Co., or to anybody who would use that for the pur-
6595 poses for which the Spring Valley Water Co. is using it.

Page 4 of my paper, I make the San Andres reservoir lands worth only about 70% of the Crystal Springs, and the Pilarcitos lands worth only about 20% of the value of the Crystal Springs, and that is based on the real estate appraisal as I took them off. More was paid for Crystal Springs, because it was not as remote as Pilarcitos. If the Crystal Springs land had been purchased in 1868 and 1869, when the San Andres lands were purchased, they would have been bought for prices materially less than were actually paid for them, so if the order of purchase had been reversed, the San Andres
6596 reservoir lands would have been worth more, very likely. (The witness here stated that he was getting mixed up on these two estimates,

and that the estimate spoken of by Counsel for Plaintiff is based purely on the estimates of the real estate appraisers, and that he wanted to change his last answer, as it has nothing to do with the time of acquirement, but is based wholly on the present appraisal.)

My former answer is true as to the first appraisal on page 2, that is to say, according to the method I have adopted on page 2 of my paper, San Andres reservoir land, acre for acre, would only be worth about 63% of the value of the Crystal Springs reservoir lands acre for acre. If you can get a fair value in a direct way, this method is so remote that it would not be used. The difficulty of getting at the value in any direct way drove me to this route. I don't 6597
want to set it up as an exact method; I want to set it up as the best approximate method from that viewpoint I can find. If I could find a more direct one I would use it. I am not sure but what the real estate appraisals of the adjacent lands is a better method than the other. The fact that they approximately coincide is accidental. The first method, the 5% method, of course, could very easily have been reversed. Crystal Springs might have been $200, and San Andres $320. I do not know. In fact, a great many variations in these figures might have been made by changing the time of acquirement.

I have seen three reservoirs of the Utica Company on the Stanislaus. I have seen the Strawberry Reservoir. I do not think of any of the reservoirs of the P. G. & E. Co. now. I have heard of Lake Spaulding, but have never been there. I have heard of Fordice, but have never been there. I have heard of Bowman's reservoir, which is an old dam. I have not heard of French Lake, or Fauchere, that I know of. I mentioned French Creek, which is a proposed power station which was purchased and started, but never completed. That was done by the P. G. & E. Co.

I think the value of those various properties for reservoir pur- 6598
poses is very much greater than the value for any other purpose, and in some cases it might be greater than 10 to 1. In my statement on page 4 of my paper, "There is no such factor as 10 to 1 in reservoir "lands in my experience", I meant that that might have been found in the experience of other engineers, but it has not been found in my experience. I am only testifying to my own experience. I am talking about the cost of that position. I am not talking about the value to the utility, and in the answer to the former question, it is the value to the utility I am talking about, and not the probable cost.

I have heard a great deal about Lake Spaulding, and this opinion is based on hearsay, and my impression of what I have heard about Lake Spaulding. The basin which is flooded there is land which has very little value for anything else; its value for reservoir purposes, and even the cost in that case might have been ten times its value for any other purpose. That would have made a very insignificant addition to the cost of that storage, because the work cost so

6599 much more than the land that the 10 to 1 factor might not have made such difference in the cost of that structure. The value to the utility might show absolutely no connection between the value for reservoir purposes and its value for other purposes, but the cost of those lands, has to my mind, a very close relation to the value for other purposes. What I mean by that is that its value for use as a reservoir to anybody who could use it as a reservoir might be ten times as great as its value for the next most available purpose, if taken in connection with a waterworks, which would need and utilize that reservoir. It follows, necessarily, that if the lands cannot be used by somebody as a reservoir, it would have no peculiar value for reservoir purposes, and the fact that I attach a value to it for reservoir purposes presupposes that it may at some time in the future be used by somebody for that purpose.

Presupposing that within some time in the not distant future a property may be used for reservoir purposes, it may very well be that its value for that use to the utility would be very much more than ten times as great as its value for its next most available use,
6600 and when I say to the utility, I mean for the use, but not to anybody who would use it for that purpose. Its value to the utility must be considered entirely in connection with the other properties of the utility, and not as a separate entity. In my valuation I have considered it simply as one link in this chain necessary to make a complete waterworks, and it is just as essential as some of the other property, but not quite so essential as the pipe lines connected with the city, because that link taken out would vitiate the storage entirely; the storage taken out would still allow the water line to be used, or the natural flow of the stream. Referring to Lake Spaulding, and assuming that it lay out in the open, and that somebody within ten years would have wanted to avail of the opportunity to convert it into a reservoir; I want to say that it might not have been worth for that use very much more than ten times the value which it had for its next most available use; its cost of acquirement need not be that 10 to 1 at all. If it were actually worth that, the payment of
6601 that sum would not be an excessive payment; it would have to be worth more than that to warrant the payment for it. Anybody who buys property ought to get it at a little less than he thinks it is worth to him, and that factor is present in every practice, whether for waterworks purposes, or for any other purpose.

I know nothing about the Phoenix Gulch Reservoir, which is somewhere in Marin County. I have never seen it, and do not know anything about the value of that land for other purposes than reservoir purposes, except in a general way; it is somewhere in the vicinity of Mt. Tamalpais. I know in a general way that $40 per acre is not ten times the value of that land, because there is not any land in that county that is worth less than $4 per acre. It was cited here

as an indication that the 10 to 1 factor did not apply in that case, 6602
and it is one of the bits of evidence that shows me that there is nothing in this 10 to 1 theory, and I am satisfied it could not apply at all.

The many storage sites on the Stanislaus River, which I investigated a few years ago, with a view to recommending acquirement, and the highest price asked for which was $25 per acre, were mountain streams with alleged dam sites below wider reservoir sites above. That land was worth $2.50 an acre for its next most useful purpose. The land they asked $25 an acre for was over the hill from Strawberry, on the middle fork; that was simply the price talked of; it was intimated, when we proposed to turn it down, that that $25 would be very much reduced. That is the highest price that was asked. There is also a site known as the Pattee Site on the north fork, below the mouth of Highland Creek.

RE-DIRECT EXAMINATION BY MR. SEARLS. 6603

The value of a reservoir site for a public purpose, to one who could use it for that purpose, might be very much in excess of the cost value which I have given, and that must necessarily be due to the return that the utility gets from the use of the property. If the Spring Valley reservoirs have a value very much in excess of the reproduction cost, that would be the only thing that would give added value, and therefore the conclusion is inevitable that they are making returns on that increased value.

I do not know of any sales of other reservoirs in use which you
could use as a basis for valuing the Spring Valley reservoirs; reser- 6604
voirs are very seldom sold. I don't happen to think of any sale of reservoirs, but I have heard of the sale of some abandoned reservoirs, built originally for mining purposes, and afterwards put to use for power purposes. The sale of reservoirs is of very rare occurrence. So rare that you are unable from that reasoning to get at reservoir values. I think the proposition of valuing these reservoirs simmers itself down to the proposition that I have outlined of figuring what is a reasonable increment in the original investment cost of these Peninsula reservoir lands to allow the company. That, or the other method, seem to be the only two methods of approaching this question of probable cost or value from that standpoint.

RE-CROSS EXAMINATION BY MR. MCCUTCHEN.

If the company had paid infinitely more for the properties than they were worth, I don't think my rule would still hold good. I have assumed, for the purpose of reaching my conclusion, that cost at the time of acquisition, and market value were identical. If cost at that time had been four or five times market value, my theory would be unsound, but I have assumed that the business was carried on in an efficient way, that the purchases were properly

made, and each purchase properly considered, and that the man-
6605 agement was good business from the start. I am more willing to assume that to be the case from my knowledge of the general construction. If the company had made an injudicious purchase in the sense that it had paid more for the property than it was worth, the interest method should be dropped, and that estimate would be unreliable to that extent. If the company, on the other hand, obtained the property for one-half or one-quarter what it was worth, the fact that they only paid half what the property was worth, would inure to the benefit of the owner, and if I could obtain the actual value at the time of acquisition, independent of the actual cost, I should use that in these figures instead of actual cost, whether it was one-half of its value, or twice its value, or ten times its value.

If, after the company acquired the property, it reaped returns
6606 from it, that at current rates of interest would represent a greater valuation than was paid for it, then temporarily the property has that greater value. If, on the other hand, the business of the company were so managed that it operated at a loss, the property would cease to have a value at that time. It might have a prospective value, but with no returns, it would have no value temporarily. A piece of real estate that is not yielding returns at the moment has market value, but this property, which for the moment was not yielding any returns, would not have any value, because it is a prospective value. It has a value to be realized in the future. I own lands that bring me in no present returns, and yet those lands are valuable. Presuming that the City of San Francisco owned this property, and did not expect to get any revenue from it, but expected to supply its people with water, it would have the same value in use, and if they were getting no returns from it, the rates presumably would be correspondingly reduced, and its value would be represented in the reduced rates to its consumers, to the people. If the business is carried on by a private company, the
6607 rate should yield a proper profit on this property, and all other property used and useful in connection with it. That would be based on its cost, increased by 5% per annum, because there is an increase in value in adjacent real estate which should not be denied to the utility property. In other words, this utility property should be worth just as much, or possibly a little bit more, as property in private ownership of the same nature.

6608 Mr. Searls: The next to the last column attached to Mr. Dillman's paper simply represents the average cost per acre of the land purchased by the company, irrespective of the amount that was converted. The last column represents the average cost per acre of the entire tract, multiplied by the number of acres in that tract in the reservoir.

Mr. Dillman's memorandum was introduced and marked "Defendants' Exhibit 132". 6609

Witness: J. B. LIPPINCOTT for Plaintiff, recalled for Plaintiff.

DIRECT EXAMINATION BY MR. GREENE. 6611

I have had to do with the driving of perhaps a dozen tunnels in the Canyon of Santa Ana, in San Bernardino County, California, along in the early nineties. I have had a long and tedious experience in connection with the driving of a tunnel for the City of Santa Barbara through the Coast Range. The tunnel was 4 miles long, and we encountered a great deal of difficulty from water, and from explosive gases, and from sulphur gases. I was connected with the driving of about 120 or 130 tunnels on the Los Angeles Aqueduct through a great variety of formations, all the way from stratified chistose rocks, and soft sandstones, up to hard granites. Beginning in 1911, I was connected with the driving of 11 miles of tunnels in the Hawaiian Islands through volcanic rock. I presume I have had to do with the driving in all of perhaps 150 tunnels, through an aggregate length of perhaps 60 or 70 miles. Lippincott

I have divided the class of work into a number of headings, first of which is drilling for rock tunnels. This memorandum is contained in the estimate which I have prepared concerning tunnels: 6612

DRILLING.

"When a small amount of tunnel work is to be done, such as "the driving of half a mile, drilling may be by hand, and the cars "handled with mules with due economy. In this case heavy equip- "ment is of small importance. When, however, a large piece of "work is involved, such as the driving of several miles of tunnel, "either in a single excavation, or an aggregate of small ones, equip- "ment becomes of prime importance. No matter how efficient the "tunnel men are, if they are supplied with air at low pressure, or "with poor ventilating devices, the tunnel cannot be driven rapidly, "and rapidity is essential to low costs."

The reason I say that the equipment is of minor importance in a short tunnel is because the first cost of equipment is not distributed over a long footage, and consequently it becomes a heavy burden. In that event the work can be driven by hand with equal economy.

"If the work is in a hard rock, particular attention should be "given to air drills. Two stage (compound) compressors should be "used, and the air delivered to the drills in the tunnel at pressures "of from 90 to 110 pounds. There are a variety of good drills on "the market. In softer rock, where clay seams, or gouge is en-

"countered, tools in which water is delivered at the point of the "drill are efficient, as they keep the drill hole washed clean, "especially at the bottom. This latter condition applies to most
6613 "of the rock tunnels, both on the Peninsula and at Sunol.

"When the rocks are soft sandstone frequently hand augers "can be used for boring instead of air drills, and the best progress "made in this way. There are no rocks of this kind on the works "of the Spring Valley Water Co. An essential feature in rapid "tunnel driving consists of good blacksmithing, that is, the putting "of a good edge on the cutting tool, and the proper tempering of "the steel. The tunnels of the Spring Valley Co. are assumed to "be driven by machine drills, and with good equipment.

MUCKING.

"The portion of the work that limits to the greatest extent the "speed accomplished in driving the tunnels is the mucking, shovel-"ing of the broken stone into cars for the purpose of removal from "the tunnel. This is done by hand in small tunnels. Numerous "machines have been invented for the purpose of lifting this muck "into cars, but they have been unsucessful. In railroad tunnels, "small steam shovels are used effectively. In the tunnels of the "Spring Valley Co. only hand mucking could be accomplished.

TRANSPORTATION.

"When a tunnel is less than a mile in length involving half "mile hauls or less, transportation of the muck and of supplies for "the work can be accomplished as cheaply with mules as by motors. "For longer hauls electric locomotion becomes the most efficient tool. "In driving the Elizabeth Tunnel of the Los Angeles Aqueduct for a "total length of five and a half miles, it was found that the trans-"portation problem of muck was little, if any more serious, for the "central portion of the tunnel than for the two ends. 6-ton loco-
6614 "motives were used. When the hauls were short they made more "trips with few cars. When the haul became longer, fewer trips "were made, but with a greater length of train. As many as 12 to "14 cars were hauled in one train, each car holding one yard of "broken stone. The amount of energy used in this longer transpor-"tation was not appreciably greater than the aggregate cost of the "tunnel work. These locomotives were used also for the transpor-"tation of men and all classes of supplies.

VENTILATION.

"Essential for the safe and rapid driving of a tunnel is good "ventilation. It ought to be possible to get back to work at a "heading within 15 or 20 minutes after the round is fired. A posi-

"tive blower which has a direct forcing action on the air entering "the tunnel is most effective. In small tunnels of a mile in length, "ventilating pipe should be 5 inches in diameter, and for those "longer, about 18 inches, with corresponding sizes of blowers. In "driving long tunnels it is found effective to run this ventilating "machine in suction immediately following the shot for about five "or ten minutes, and then reverse it and blow the fresh air into "the heading.

POWDERS.

"The powder used underground should be one that is as little "noxious as possible. The fumes of ordinary dynamite are deadly "when breathed extensively. The powder manufacturers have suc-"ceeded in eliminating a large portion of these noxious fumes, pos-"sibly by more complete combustion, and have produced high ex-"plosives known as gelatine and ammonia powders, designed for "tunnel work. For the harder rock, where greater scattering "power is required, the gelatine powders are the best. These are "made in percentage of nitro-glycerine of 280. Ammonia powder is "manufactured from the nitrates of ammonia in nominal strengths,
"ranging from 20% to 40 and 60%. The ammonia powders, which 6615
"are nominally 60%, do not appear to the writer to have a greater "strength than the 40's. These two powders are the principal "tunnel powders used on this coast. The higher the percentage of "nitro-glycerine, the greater its shattering power. The powders of "lower percentage, such as 20%, or the Judson powders, are used "for lifting rather than shattering.

" Great care and skill is necessary in driving tunnels to prevent "the undue shattering of the sides and roof by improper placing of "the holes, or by over-shooting. Particularly in the softer rocks "there is apt to be a serious over-breakage caused by carelessness of "this sort. In the softer sandstone that can be bored with augers, "the tunnel should not be shot within a foot and a half, or two "feet of the outside line.

RAILS.

"It is essential for rapid driving of tunnels that the rails should "be of such weight as to permit of the rapid running of electric "locomotives without the trains being frequently derailed. Rails "less than 20 lbs. in weight are a source of annoyance and expense.

METHOD OF DRIVING.

"The method of driving tunnels of small section consists of "drilling a set of holes in the center of the heading or face of the "tunnel in a wedge shaped direction; other holes are driven around "the perimeter of the section. These holes are loaded, and

"the fuses cut in such lengths that the wedge shaped group of holes "in the center of the face are first fired, blowing out this wedge "of rock first. The fuses for the side holes are timed next to go, "breaking in the sides towards the center opening. The top holes
6616 "then fire, and last of all those in the bottom, which are called the "'lifters', and which are long and heavily loaded, are exploded. "This last explosion throws the pile of broken stone back from "the face in such a manner as to permit the miners to quickly get "back to the heading and set up their drills. Usually one round of "holes is thus fired and cleaned up for each shift, the holes being "drilled to depths of 6 or 7 feet. In certain rapidly driven tunnels, "however, these holes have been made of less depth and two rounds "are fired for the shift. In small tunnels, up to outside dimensions "of 12 feet by 12 feet, the entire face is broken with one round of "holes. In other words, the entire section is driven as one heading. "Then they are larger, such as railroad tunnels, it is customary "to drive a heading usually on top and in somewhat the manner "above described, following this up some 100 or 200 feet behind "with other crews of men who enlarge it to the desired size. The "cost per cubic yard of making this enlargement is much less than "that of driving the heading. Prilini, the Italian tunnel authority, "states that with a given kind of rock it costs ten times as much "to drive the heading as it would to excavate the same class of "rock on the outside, and give times as much per unit to make the "enlargement.

"The breaking out of the center wedge of rock is manifestly "the most expensive and tedious part of the work. For this reason "it is impracticable to establish a cost per cubic yard of driving "tunnels and use this established rate for tunnels of different sizes.

"Experience in driving small tunnels, such as that at Santa "Barbara, which is in part 5′ x 7′, proved it to be more economical "per lineal foot of tunnel driven to increase the size of the section "because of the amount of crowding that occurs in the small size.

6617 "WIDTH OF TUNNEL:

"The width of the tunnel should be such as to provide approximately for the following:

"2 outside posts	1 ft.
"2 walls	1 ft.
"Ventilating pipe	1 ft.
"High pressure air pipe	0.5 ft.
"Railroad	3 ft.
"Drain ditch	2 ft.
"Total	8½ ft. for width

"HEIGHT OF TUNNEL:

"The height should be sufficient to provide clearance with the "track, well surfaced out of the water, and with a trolley wire over-"head. This usually required a height, in order to be comfortable, "of about 8 feet. In other words, to provide space for the different "equipment and for the rapid driving of an ordinary rock tunnel, "it should be about 8 feet wide and 8 feet high.

"The writer has laid out a series of tunnels in the Hawaiian "Islands which were intended to convey moderate quantities of "water, with a dimension of 8 feet in width and 7 feet in height. A "long tunnel, 8′ x 8′ outside dimensions, can be as effectively and as "cheaply driven as one of smaller size.

"LENGTH OF TUNNEL:

"Provided good equipment is installed, consisting of air com-"pressors in duplicate and of substantial capacity large sized blow-"ers and ventilating pipe, good rails and electric equipment, the "length of the tunnel up to perhaps 6 or 8 miles is immaterial in "determining the unit cost of doing the work; in fact, the cost of "equipment is distributed over a greater number of lineal feet. The "center of the Elizabeth tunnel was driven with as low a rate per "foot as the two ends.

"The unit cost that obtains on the aqueduct tunnels is low be- 6618
"cause the length of the job permits the men to become well or-"ganized and skilled, and the cost of the equipment was distributed "over nearly 50 miles of tunnels, it being moved from point to point "as required.

"OCCASION FOR HEAVY EXPENSE:

"The things that make for heavy expense in driving tunnels "consists, first, of the ground being badly shattered, or what is "termed blocky and heavy ground, with clay seams and well estab-"lished lines of cleavage. In shooting such ground the powder "breaks to the seam and usually not beyond. After the excavation "is made, the rock often slips into the tunnel from its place in the "sides and roof, making the ground dangerous. Ground of this "kind has to be supported with timbers immediately, and owing to "crushing they often have to be replaced. It is in this class of "material that most of the tunnel accidents occur.

"The rocks of the Peninsula and at Sunol are largely of this "class, and while they are intermittently hard and soft, they are "full of seams and cleavage lines, and many of these seams are so "filled with wet clay that movement of the rock is lubricated. Prac-"tically the only saving of soft and blocky rock, as compared to "those that are harder, is in the drilling and in the amount of powder

"used. Additional cost is incurred in timbering. As the finished "size of the tunnel must be the same, whether it is timbered or un- "timbered, the placing of the timber requires the excavation of a "larger section. Timbers in the smaller tunnels are usually 6″ x "8″ or 8″ x 8″ posts and caps, with 2″ lagging. In lining, this also "involves placing a substantially greater amount of concrete to fill "all the cavities and spaces between the timber sets. We there- "fore have a cost per lineal foot in the softer and more blocky rocks "that often is as great as the cost per lineal foot of driven tunnels
6619 "in the harder rocks. The Sunol tunnels are estimated to be all "timbers and those on the peninsula one-half timbered, except the "Merced and Honda, which are all timber.

"Second: Other elements that increase the cost of driven tun- "nels are water and gas. The Merced tunnel was driven in part "below a prevailing water level. The material excavated in this "instance was dune sand. Saturated sand runs and caves unless it "is handled with great care.

"In estimating the cost of the Merced Tunnel it was considered "necessary to so handle the water that was encountered that the "level of the water plane be depressed below the grade of the "tunnel so that the sand will not be saturated. This pumping adds "substantially to the cost of the work. Large quantities of water "encountered in rock tunnels also delay the work. It is believed "that all the tunnels on the peninsula would be wet tunnels, but "probably with small quantities of water.

"Gases are sometimes encountered in tunnels on the Pacific "Coast, such as sulphurated hydrogen, which affects the eyes of "the miners, or oil gas, which is inflammable and explosive. Both "of these gases were encountered in the Santa Barbara tunnel and "were the occasion for delays. It is probable that some of the sul-
6620 "phur gases would be encountered in the tunnels of the Peninsula "and at Sunol, but not the Hydrocarbons.

"Third: Hardness of the rock makes slower drilling, and re- "quires more and higher-priced powders."

Mr. Lippincott: In the lining of the tunnel it is customary to set up the crushing plant, and the mixing plant, on the outside of the tunnel, load the material on to cars of approximately 1 cu. yd. capacity, run these cars into the tunnel, and then place the concrete by hand behind the form boards and in the roof. The process of placing concrete by compressed air is only a development of the last year or two, and was not considered as the method in use in lining these tunnels.

DIRECT EXAMINATION BY MR. GREENE.

I went to each tunnel of the Spring Valley Water Co., and I have made an appraisal of the reproduction cost of those tunnels.

The volumn entitled "Tunnels, J. B. Lippincott, December 10, 1915," is that appraisal.

This volume was introduced and marked "Plaintiff's Exhibit 133".

Mr. Lippincott: In this exhibit I have first considered a number of tunnels which I thought were rock somewhat similar to the rock to be encountered in the Peninsula and at Sunol. On page 1 I refer first to tunnel No. 6, which is a tunnel that Mr. Ellis I think is probably acquainted with. It was near the Soda Springs hoist, near Little Lake, in what we call division No. 5. The tunnel was in a 6621
medium hard granite that was blocky and full of seams, and it had to be largely timbered. The work in that particular tunnel was done by hand. The height, unlined, was about 8 ft. 5 in., and it was 7 ft. 10 in. wide. Page 1 gives the details relative to that tunnel. I give an excavation cost for that tunnel of $15.05 per foot. Below that are certain lining costs, the cost of rock and cement, cost of mixing and placing, $1.50, which is below the average cost for that; also the cost of setting frames, plastering, and superintending, aggregating for the direct cost on the lining $7.06 per lineal foot. The engineering, which consisted of surveying, giving centers and grades, 18 cents per foot, did not include overhead expenses. That makes a total direct cost of $22.29 per foot for the excavating and lining of the tunnel. They kept some cost data in the field as to the indirect expenses on that piece of work which aggregated $5.70. I looked up the detail of that cost data, and found there were seven indirect expenses that it did not include. The indirect expense for all the work on division 5 amounted to 36½%. Using this figure of 36½% it amounts to $7.65, or $29.94 per foot for this finished and lined tunnel. Those figures are the actual cost figures taken from the Los Angeles Aqueduct.

Questioned by Mr. Searls.

They were furnished by Mr. Clemens, the cost accountant.

In the same way I discussed the cost of driving and lining tun- 6622
nel 28 for both direct expenses and indirect expenses. The direct expense for excavation, timbering, lining, and the item called engineering, which really was surveying, was $22.46 per foot. The auxiliary expense on that division of the work, which was what we call the Jawbone Division, was 32.3%, amounting to $7.25, or a total cost of $29.71 per lineal foot. This tunnel was in a soft granite that was driven with very considerable rapidity.

Questioned by Mr. Ellis.

Those were practically all the same sections on the Jawbone, but they were different from the size of the tunnel on the Little Lake Division. This was Preston's Tunnel. The excavation for the timbered section was 3.74 cu. yds. per lineal foot. For the untim-

bered section it was 3.045 cu. yds. per lineal foot. That is the theoretical yardage.

Questioned by Mr. Dillman.

6623 I don't know what the actual yardage was. There probably was an over-breakage there—it would have to be a guess—of perhaps 10%. I don't know how many yards of rock actually came out of that tunnel. That is a very elaborate thing to determine with exactness.

Questioned by Mr. McCutchen.

We have tried to determine it on some tunnels by calibrating them with a great deal of detail, but only with a few feet.

DIRECT EXAMINATION BY MR. GREENE.

I consider the yardage matter of very secondary interest. In certain tunnels, as I remember it, where we did make a great deal of effort to determine the over-break, it was in the neighborhood of 10% as compared with the theoretical excavated section, and of course a very much larger percentage as compared with the concrete section.

Referring to the direct and indirect or auxiliary charges in regard to tunnel No. 6 and tunnel No. 28, page 1: We had a good deal of figures as to the exact definition of overhead, and I have used it in my first examination, perhaps not exactly in the same way that you have. What I mean to include by this percentage is what we term auxiliary expenses and general field expenses, and not all the different elements that have been considered by Mr. Hazen and Mr. Metcalf.

6624 Tunnel No. 9 was driven in the softer broken granite. It was a tunnel that was not so much timbered, and the detail of that cost is given on page 2. The thing I have endeavored to do with these tunnels is to pick out tunnels that somewhat approximate in the character of material the tunnels you have had to do with on the Peninsula. We have had very much harder tunnels, and much more expensive tunnels in cost per foot, but these tunnels somewhat approximate the conditions on the Peninsula.

Questioned by Mr. Dillman.

These that I have read are all granite.

DIRECT EXAMINATION BY MR. GREENE.

I don't think there would be very much difference per foot in driving the Sunol tunnels as compared with the Peninsula tunnels. On page 2, in considering Tunnel No. 9, we have made the studies in the field as to indirect cost, which are shown to amount to $5.70, but they do not include all the more general expenses, such as the cost of reorganization, and things of that sort, and the general
6625 losses. I have used in the final figures given there the percentage of 36½, which was the indirect expense of that division No. 5.

Referring to cost of reorganization; we had some trouble with our bankers at one time, and had to reduce our force from 100% down to about 33%. We had to discharge a great many men, and store a great deal of equipment, and then afterwards we had to get it out of storage and put it back to work. That was one of a good many different items actually omitted on this piece of work.

This is Tunnel No. 9 on Division No. 5; the total cost of Division No. 5 was \$949,650. This division consisted of \$41,351 for covered conduits; \$867,168 for tunnels; \$41,131 for syphons. The aggregate cost being \$949,650. The details of these auxiliary, or indirect expenses, were as follows on this division:

General engineering	\$ 13,033	6626
Surveys	10,754	
Pipe lines for domestic supply	20,207	
Maintenance of pipes	1,981	
Main telephone	3,008	
Maintenance of telephone	3,947	
Local telephones to construction camps	2,105	
Maintenance of local telephones	175	
Roads and trails	30,403	
Maintenance	896	
Buildings, that is for construction purposes	20,320	
Material yard building	1,720	
Low tension power lines	544	
Division administration	46,828	
Miscellaneous tests	1,348	
Expending sacks, which means lost or injured cement sacks	2,941	
Patrol	000	
Miscellaneous lists	11,220	
Reorganization	1,166	
Replacements	1,498	
Equipment, this is a net figure	147,370	
General equipment	9,200	
Miscellaneous, general	16,475	
Making a total of	\$347,137	

or 36½%.

Those indirect charges distributed over the entire division amounted to \$8.87 per foot.

In a similar way I have taken up Tunnel 35, which is between Water Canyon and S. P. Canyon in a soft, blocky granite. It amounted to \$31.91 a foot for direct costs, and \$10.31 a foot for indirect costs. The length was 5,128 feet. It was about 11x 11 gross outside measurement. 6627

Tunnel No. 38 was in decomposed granite, and talc seams. The cost is given per foot for each end. The average for the tunnel is given at the bottom of the page, and amounts to $35.51 per foot for direct costs, and $11.47 a foot for indirect costs, making a total of $46.98.

Next page contains some notes on the cost of framing and placing timbers in tunnels. These figures vary widely between different tunnels; in some tunnels where the ground is heavy, it costs very much more to place timbers, and in other tunnels where the ground stands up fairly well it costs less to place timbers. It is very difficult to get clerks in the field to distribute the accounts in just the same way. These figures show that the estimated cost of labor and livestock in framing and placing tunnel timbers in the Elizabeth Tunnel was $49.50 per thousand feet board measure. In Tunnel No. 9 on the Aqueduct it amounts to $12.50. In Tunnel No. 6, which is right adjacent to it, it amounted to $26.25. These figures are of interest because I have used as an estimated cost of framing and placing timbers in the Spring Valley tunnels $20 per thousand feet B. M.

On page 5 is given, in a good deal of detail, not the total cost of the Santa Barbara Tunnel, but the cost of running different portions of it. This tunnel was in sandstone and shale alternately, and the materials blended from one to the other.

The first portion of the work is for the excavation cost, and the next portion is for the lining cost. There is a figure given down at the bottom of the page which applies to those detail figures for
6628 those lengths named. The word ''lining'' in the middle of page 5 is a heading for that group of costs which are given there, and which show the cost per foot of placing a concrete lining in that tunnel. The average of those figures is $9.30. There is not the segregation of accounts—a classification between direct and indirect expenses there that we used on the aqueduct, because the accounting was not done in such detail at that time.

The costs in the last two columns up above, that is miscellaneous and total, are cost per foot. The most satisfactory figures that I have with reference to the Santa Barbara Tunnel are given on page 6. It is stated on that page that the total cost per date, as per the office accounts for that tunnel, was $718,176. That included all the items that entered into the construction of that tunnel, with the exception of the general executive expenses of the water department and the office at Santa Barbara. Of that $718,176 the accountant has taken out certain indirect costs. This segregation is one that he made. They are as follows: Taking over the contract—that was from the contractor, $11,607.50; preliminary surveys, land, pipe lines, reservoirs, roads, trails, telephones, water gaging, $67,000;
6629 overhead, surveys for dam, diversion tunnel, and excavation—that

overhead was for extra charges for long hauling in the tunnel; $38,000. The estimated cost of "side-cut" or cave was where we had a very serious cave in the tunnel that stopped the work at the head perhaps 4 or 5 months in which we could not get through, and we had to go around it, $35,400; administration costs, closed down for fire, explosion and accident, $7,000; commissary losses, $6,210. That makes a total of $175,217.

There was also expended in lining, which the accountant estimates, $72,000 for 8,000 feet. That is estimating it at $9 a foot, which is slightly different from $9.30 shown on the previous page. There was also paid on matured bonds $16,000. Transfer to waterworks fund, $12,567. These last three items of lining, matured bonds, and transfer to waterworks fund, amounting to $100,567, are taken out of the cost account of driving the tunnel altogether, and are disregarded.

The auxiliary or indirect expense is then taken out, leaving a net cost for direct tunnel construction of $442,392, which, divided by the length, 19,650 feet, amounts to $22.65 per foot. Now, if we take the indirect cost, $175,217, and divide it by the direct construction, and the lining costs, we get a ratio of 34.1% for auxiliary expenses, or indirect expenses for the driving of that tunnel.

We will get then the following average cost for this tunnel: 6630

Excavation and timbering	$22.65	
Indirect cost	7.75	
Total cost of excavating and timbering		$30.40
To which should be added the cost of lining		9.00
Making a total of		$39.40

per lineal foot for that tunnel.

And that tunnel, by the way, is a very small tunnel. We started driving it with a width of 5 feet and a height of 7 feet. We specified in the original contract that the tunnel must be at least that wide, and that the contractor could drive it as much wider as he saw fit. After trying to drive a smaller section, the contractors, of their own volition, widened the tunnel to 6 by 7, and even then it was small and crowded. I laid that tunnel out a good many years ago, and never will lay out so small a tunnel again.

For the comfortable working and driving of the tunnel and the breaking of the rock, I consider a size about 8 by 8 the economical size to drive, and that you do not save anything in making your tunnel any smaller than that. That means the outside rock excavation dimension. If you put in a lining, say ¾ of a foot thick on

each side, that will take a foot and a half off the 8 feet, and leave about 6 feet in the clear for the lined tunnel that did not have to be originally timbered. If you had to timber the tunnel, it would be
6631 equivalent to less than 6 feet when finished. The same ratio does not apply when you get to a tunnel larger than eight feet. I should say that above an 8 x 8 tunnel it would increase in cost by the enlargement of the section. But it does not increase in cost at any given rate per yard. The law of diminishing cost per unit applies. You have no such indirect cost of labor, and within certain limitations, a larger diameter would not proportionately increase the cost per yard, and in addition to that, the first break you make in a tunnel has to be a small, wedge-shaped piece of rock, that comes out of the center of the face, and then you break into that wedge from the two sides and from the top and the bottom. Now, it is the taking out of that heart or center that is the most expensive. As your tunnel gets large the cost of breaking into this center cut, as we call it, becomes less and less, until you get to the size of a railroad tunnel, and there you usually work it in two headings, the smaller heading, which is expensive, and the rest of it is an enlargement which is less expensive.

Questioned by Master.

I have not any tunnels here larger than 8 x 8, unless it is the waste tunnel.

Questioned by Mr. Searls.

As to the Santa Barbara indirect cost, I have nothing any further than this group of figures which were made for me by the accountant down there sometime ago and which are given on page
6632 six. I wish I could segregate that further for you, but I can't; I have not the information to do it. The preliminary surveys of cost were largely for the tunnel. The lands were certain rights of way we had to acquire for the tunnel. They were rather small and inexpensive costs. We got the bulk of our rights of way by stipulating to furnish a certain amount of water, about 12 miner's inches, from that tunnel to the land-owners, in consideration of the rights of way. The pipe lines were pipe lines for water for the camps. The reservoir, as I remember it, was the purchase of certain land over on the Santa Inez River. I don't remember the relation of reservoir costs to tunnel work. What I was doing there was to take all of those items out of the amount charged to the tunnel in order to get the direct construction cost of the tunnel.

The indirect costs of 34.1% had no bearing on the present case. I was going to qualify my answer to that effect. I think there can be no question about the direct excavation cost of $22.65, or the $9 a foot for lining. But there is a question about the $7.75 a foot
6633 for indirect cost. It was my intention to give all of the information I had at my disposal for whatever it was worth.

The Master: We cannot use the figure of 34.1 as a guide in this case.

Mr. Lippincott: On page No. 7, I give a table which contains the general information concerning all of these tunnels.

Questioned by Master.

This is a resume of the tables that have gone before. I think the table, so far as I can see it, is clear.

NINETY-SECOND HEARING. FEBRUARY 7, 1916.

Witnesses: J. B. Lippincott for Plaintiff.
John J. Sharon for Plaintiff.
Allen Hazen for Plaintiff.

(The Master ruled that all testimony of Mr. Haehl, which was founded on an average of agricultural value for these lands, indicated in his sheet, and a percentage relation between cost and the value, will be rejected and that any statement in Mr. Dillman's memorandum to the same effect, will be rejected. As regards the sheet, which was offered in evidence by Mr. Haehl, the second part of column 7 and column 8, the first three items on the list will be rejected.) 6634-6639

Witness: J. B. Lippincott for Plaintiff. Lippincott

DIRECT EXAMINATION BY MR. GREENE. 6640

On page 9 of my report is a table headed "Sand for Tunnels", in which I have given certain tunnels, and have started with a base price of sand from rail point near San Mateo, giving the distances hauled, the rate per ton-mile, and the amount per cubic yard, and certain other details. I did not see any sand on the Peninsula suitable for the making of concrete, and assumed that the sand is brought over from the Niles Cone. The broken stone we assumed we get locally. In the last column of this table, on page 9, is a notation "used $4.50"; I think it is possible, with a good deal of expense and difficulty, to roll sand possibly from the stone in the local quarries, although the rock is not such rock as is well suited for that. I have twice had occasion to do that, and in both instances, after rolling some sand in that way, I have given it up and gone back to hauling long distances, because it was rather unsatisfactory, largely in that the machinery that was used for the purpose, was frequently breaking down and causing trouble. That had the effect of increasing the cost, and delayed the work. 6641

Questioned by Master.

Mr. Metcalf: This f.o.b. figure, $1.15, compares very closely with other evidence that our witnesses have given. It is the same figure as sand for the dam.

Mr. Lippincott: I think the figure that was used was 85 cents a ton, and a ton was considered about 1 1/3 yards.

Mr. Metcalf: Yes, about that; 2700 lbs., I think.

Questioned by Mr. Greene.

Mr. Lippincott: Referring to the comment at the bottom of the page, "1 cubic yard is assumed to weigh 2700 lbs."; that is the weight I have given in hauling figures I have used. I went to see some of the parties who deal in these sands, and they tell me that these sands are washed and sorted, and that the sands that are shipped from the Niles pits are usually heavier than 2700 lbs.; they tell me that they usually weigh about 3,000 lbs. to the yard wet.
6642 They did not tell me how much it would weigh when dry, but I remarked that I was using 2700 lbs., and they said that the sand they shipped weighed more than that.

Questioned by Mr. Searls.

The person I talked to was the sales agent for the E. B. & A. L. Stone Co.

Questioned by Master.

I am assuming that the sand is delivered from the train on the Southern Pacific Railroad at Niles; the hauls would be hauls as a rule that are quite steep in many places, and crooked; for instance, take the Bald Hill Tunnel Road, while the hill is not very long, it is rather difficult automobile driving to get from San Mateo, for instance, to the West Portal of the Bald Hill Tunnel. When you get to the Stone Dam Tunnels, Nos. 1 and 2, you go over roads, some of which are good, and some of which are steep. I was figuring on hauling with mules.

DIRECT EXAMINATION BY MR. GREENE.

Page 8 of my table gives the details of those hauling estimates.
6643 I have been connected with the letting of a good many hauling contracts, and advertising for bids, and where the roads are fairly good, and the grades not steep, where the drivers can use from 8 to 10 or 12 animals, and 2 wagons with one driver, it has been my experience that hauling of that kind on the desert is let usually for about 25 cents a ton-mile. When you get into hauling on hill roads it goes up to prices anywhere from 25 to 50 cents a ton-mile. We made about as hard a try as anybody could to haul with caterpillar engines on the aqueduct. We got the most skillful men we could from the factory to help us handle them, and our costs ran up higher with those engines than it did hauling with animals. It is not perhaps the fact that the actual cost per ton-mile would be any greater to haul that way, but where you have a group of men waiting for the delivery of a uniform fixed amount of material, and there is a breakdown which delays the delivery of that equipment, the indirect costs which result from that delay are serious.

I have not personally had experience in hauling, except at Santa Barbara, with automobile trucks, but after making a good deal of inquiry, it is my judgment that where the roads are first-class, that the hauling cost with automobile trucks is probably better than the hauling cost with mules, but where you get the roads that have not a good surface, the breakdowns and the depreciation of equipment balances what can be done with livestock.

To explain my difference on page 8 between the weight for rock and the weight for sand and cement; I am assuming that the rock quarry that is used for furnishing stone for these tunnels is the one that previously has been used near the west end of the Davis Tunnel. That is pretty well up in the mountains, and some of those hauls 6644
are downhill hauls; for instance, to the Davis Tunnel itself, the Pilarcitos Tunnel No. 2, and to the Stone Dam Aqueduct Tunnels Nos. 2 and No. 1, these hauls are downhill hauls, but are on crooked roads, on which a long line of teams cannot be used. On the contrary, sand always has to be handled with a substantial uphill haul, which I thought was more expensive.

Questioned by Mr. Searls.

I considered all the equipment charges covered by my indirect percentage, and bunkering and so on are covered by that percentage. These figures are just the indirect charge on the hauling and the loading of the sand, and I was assuming that we were doing this by day labor ourselves in this estimate. This includes the cost of the teams.

Questioned by Master.

I am not including any element of profit in any of these prices.

DIRECT EXAMINATION BY MR. GREENE. 6645

Referring to page 9, under the heading "Sand", the charge of 15 cents for loading is the cost of shoveling from cars into the wagon, and that is a distinct charge from the 40 cents given in the table on page 8, the per ton mile rate. I have assumed the same base there as I did for the cement for Crystal Springs Dam. I have put in an item there, the next from the last column, for handling the cement twice. That is, once off the car on to the wagon, and the second time off the wagon on to the ground. I cannot give any specific data on that figure, except that it is my recollection that the cost of sacking and handling cement on to the cars usually amounts to about 4 or 5 cents a barrel. I have used the figure of 4 cents here for each handling per barrel, that would be 1 cent for each bag.

Page 11: I have made an estimate on the cost of doing the lining on certain of these tunnels that are lined with brick. That is, the cost of repeating that operation with brick, but they are not the figures that are used in the final table as to the cost of driving these tunnels. A number of these tunnels are brick-lined tunnels,

and they are also small tunnels. Take the drawing shown on page 17-a; you will see there a tunnel which is a finished section, 3 ft.
6646 wide, and 4 ft. 8 in. high. That is a brick-lined tunnel. I have gone into a discussion heretofore that I considered that there was no economy in making tunnels as small as some of these tunnels are. I have made an estimate for a tunnel which I consider could be driven to replace this one, and lined with concrete. As a matter of fact, I don't believe, as a working feasible proposition, that a tunnel of this shape could be lined with concrete. It might be done as a demonstration proposition, but as an economical, or an efficient working proposition, I don't think you could make a tunnel of that shape, 3 ft. wide, and 4 ft. 8 in. high, lined with concrete, because it is too small to work in. While I have prepared a figure here on the cost of brick work, and of lining the tunnels with brick, I have not used those figures.

Questioned by Master.

On this Bald Hill Tunnel I have used the figure of $25.36 for the tunnel complete. On page 16 an estimate is given of the Bald Hill Tunnel, which shows for concrete lining the following figures:

6647	Excavation	$16.80
	Timber	1.47
	Lining with concrete	4.29
	Backfilling	2.80
	Total	$25.36

DIRECT EXAMINATION BY MR. GREENE.

If brick are used, we get a figure of $35.92 per thousand. On the next page it shows a cost of $4.82 more per linear foot of tunnel if concrete were used. On page 29-a is a table which gives a summary, and in that summary it shows in the third column how each one of the tunnels in question on the Peninsula is lined. That is, in fact, lined. It gives in the fourth from the end column the cost per lineal foot used in estimating the tunnel, and the total cost of the tunnel. On the last two columns are given the figures that would have to obtain in case you consider these tunnels lined with brick.

I have figured this both with concrete lining and with brick lining, and in case the brick lining is more expensive, I have adopted the concrete figures, and I have done it in spite of the fact that a number of these tunnels are so small that I think that as a work-
6648 ing proposition, concrete cannot be put in them.

Questioned by Master.

Referring to the relation of the figure $28.10, on page 11, to these other figures: The figures given on page 11 are figures as to the cost of purchasing the brick, hauling it, handling it off the cars,

and on to the wagons and back, and the cost of placing the brick, without the sand and the cement; in other words, they are the figures as to the specific cost for the brick itself per thousand of brick, and presuming that a thousand of brick would give 2 yards of masonry.

Questioned by Mr. Searls.

The $17 is the figure I have used as the labor cost in placing the brick. In this table the only thing I have done is to give data relative to the cost of brick itself. In order to get the cost of my brick lining complete, I would add to that the cost of the material; that is, the sand and the cement materials, delivered on the job, and lumber and rock, also. 6649

Questioned by Master.

If you take the figure of $35.92, and subtract from it the cost of sand used, $1.90, and the cost of the cement used, $5.92, you get a figure of $28.10, which is the same as the figure in the upper right-hand corner of page 11. It is simply an effort on my part to show that in using a concrete lining, I have used a method that has arrived at a figure that is less than if I had used a brick lining. 6650

I did not consider, in the figures for lumber, that they come into the estimate if I am using brick. The figures for lumber, page 12, are the cost of lumber used for timbering the tunnels. I have assumed that half the tunnels on the Peninsula were timbered. Subsequently we have learned, from Mr. Schussler, that a larger percentage than half of the tunnels are timbered, but I have not changed those figures, and I have assumed that one-half of the Peninsula tunnels are timbered. All of the Sunol tunnels are timbered, all of the Merced tunnels are timbered, and all of the La Honda tunnels. Those lumber costs are the cost of the lumber for the timbering of the tunnels.

Mr. Greene: What we have covered by stipulation is lumber in place, which includes the labor of placing the lumber, and any other incidentals in connection with it, but does not include everything in connection with flumes, except excavation.

Mr. Metcalf: There are some miscellaneous items which aggregate a few thousand dollars in the total estimate. We did not agree 6651
upon those. We agreed upon the lumber in place, and we include caulking, tarring, and that sort of thing.

DIRECT EXAMINATION BY MR. GREENE.

Mr. Lippincott: Referring to the brick, at $7.50; I assumed that the price of brick was $6.50 in San Francisco, and the transportation charges would be about $1. I got information, first from Mr. Lawrence, and afterwards confirmed my figures by going to the McNear Brick Co. and getting prices. Brick goes through a big fluctuation in prices, and between 1909 and 1916 it varied from $6.25 to $9 a thousand in San Francisco. I assumed a figure of $6.50, and

a freight charge of $1. I was told by this agent of the McNear Brick Co. that there are a good many San Jose brick that come into the San Francisco market, and that probably these San Jose brick might be delivered at San Mateo at the same figure as they are delivered in San Francisco; consequently, my figures in brick may be high by 50 cents, or perhaps by $1. It is a matter, though, of very little consequence, for two reasons: In the first place, the number of brick used in the tunnel is not very large, and the rate per thousand would not produce any great effect on the cost per foot estimate. The other
6652 reason is I did not use the price of brick anyhow, so I don't see that it cuts very much figure.

The price that I used on lumber was about $16 a thousand at San Francisco, and $1 a thousand for freight, board measure. I got quotations from the purchasing agent of Spring Valley Water Co.; then I also had the figures on very large purchases of lumber, made by the Los Angeles Aqueduct, for these periods. We were buying lumber in very large quantities, and have it delivered at wharves at Wilmington and San Pedro. I was guided by those Los Angeles Aqueduct figures to a great extent.

In the price of lumber there is a very great range. Very much more of a range than there is in the price of brick, depending not only on the transportattion of the lumber, but also depending on the sizes of the lumber. For instance the lumbermen will quote you what they call a base price; that will relate to certain dimensions, and as you vary from those dimensions, your price varies. In the same way the price varies tremendously with the quality. The ordinary lumber is what they call merchantable lumber; you refer, for instance, to rough Oregon pine, merchantable No. 1 and merchantable No. 2; the difference between the merchantable No. 1 and No. 2 is that the No. 1 material is firm and strong, and free from serious defects. It may have knots in it, and things of that sort, but the knots must be tight; they must not be knot-holes with the knot gone, for instance. I should say that a price of $16 for good merchantable Oregon pine lumber—not culled lumber—but the best quality merchantable at San Francisco, would be about $16. I
6653 would not use the same price at Los Angeles, as there is a difference between the San Francisco harbor price, and the Los Angeles harbor price, due to the freight rates.

Questioned by Master.

The period of active construction of the aqueduct was from about 1908 to 1913.

DIRECT EXAMINATION BY MR. GREENE.

A difference of $15 and $17 in lumber would make a difference of about 20 cents a foot in the cost of the tunnel; 100 feet B.M. in
6654 a tunnel, per lineal foot, approximately at $1 a thousand, would

make 10 cents a foot. The placing cost of lumber in tunnels differs greatly in different tunnels. If the ground is heavy, and what we call blocky, it costs more to place the lumber than if the tunnel stands up well. I have figures which vary from $12.50 to $45 per thousand for placing lumber in tunnels. I have used $20, which appears on page 12.

Page 13, taking rock for tunnels; this rock is rock that is to be quarried and crushed, and used for the making of concrete. I have taken a cost of $1 a yard for quarrying and crushing that rock, assuming that the quarry where the rock is obtained is about half a mile from the west portal of the Davis Tunnel. The hauling rates are shown in column 4; the cost of the stone delivered is shown in next to the last column. I have had to do with the quarrying and crushing of stone in a great many quarries, and I should say that the figure of $1 a yard was a fair average figure. It is less, as I remember it, than the figure that was quoted to me by a rock-crushing plant, situated between San Mateo and Crystal Springs Dam. It is based on an experience that I have had with probably 20 or 30 quarries.

The figure of $4.02—cost delivered, Stone Dam No. 1—was based 6655
on the assumption of the delivery of broken stone from the Davis Quarry, and I thought that by exploration work it was probable that a quarry could be found in a neighborhood closer than the Davis Tunnel, that could deliver that rock for $3. I don't know where that place is, but I have put that note there; "used $3".

On page 14 I have these notes: "Peninsula System, all tunnels
"estimated to be timbered one-half length; for brick lining, used 6656
"5 barrels of sand—which would amount to .74 cubic yard; 2½ "barrels cement per thousand brick. For concrete lining used 1 of "cement, 3 of sand, and 6 of stone."

I am informed, since I made this estimate, by Mr. Hazen, and some of the other engineers, that the mixes used were actually richer than that.

For the backfilling I say use a mixture of 1 part of cement, 6 of sand, and 12 of stone. On page 17-a there is a ring shown, which is supposed to be the brick lining of that tunnel, and there are certain spaces between this ring and the timbers or excavated portions of the tunnel; those spaces would have to be filled. It has been my practice, where I have had conditions of that kind to meet, to make a very lean mixture of concrete, one that has just barely enough cement in it to stand up. That is what that means. The table shows the yardage, and the barrels of cement, sand and rock that would be used with a mixture of 1-3-6 and 1-6-12, with certain assumed voids in the materials. I have a memorandum here of a conversation with Mr. Schussler about the timbering of the tunnels,
which I will read; "Stone Dam No. 1 tunnel, mostly timbered. Stone 6657

"Dam No. 2 tunnel, largely timbered. Pilarcitos No. 1 tunnel all "timbered. Pilarcitos No. 2 timbered from two-thirds to three-"fourths. Sunol Tunnel, all timbered. Honda Tunnel, all but 800 "feet timbered. Merced Tunnel, all timbered. Bald Hill Tunnel, "all timbered. Davis Tunnel, all timbered. Spring Valley pipe tun-"nels all timbered."

Mr. Metcalf: That was an offhand statement made by Mr. Schussler to me over the telephone, and was not after careful investigation in details.

Mr. Lippincott: On page 15 is a table of the cost of materials delivered to the different tunnels. It is simply a resume of figures from the preceding tables. I have endeavored to go through every step of this estimate in detail. It was made absolutely independent of every other estimate that was made on these tunnels, or of any cost figures that were available on the tunnels. It was not done in consultation with Mr. Hazen. After I had finished my estimate, I
6658 compared my figures with Mr. Hazen's, but did not make any changes in mine after we compared them.

Questioned by Master.

Where I have, under the heading of "Excavation", multiplied \$12 by 40%; that is not arranged very well; it should be "Excava-"tion \$12; indirect expenses, \$12 multiplied by 40%, or \$4.80". The sum of the \$12, plus the \$4.80, which was to cover all such things as equipment and camp layout, and accidents, makes \$16.80. Using the unit cost figures which I had for the timbers, and adding for indirect expenses and assuming one-half of the tunnel timbered, I get an average cost per foot for timbers of \$1.47. I learn from Mr. Schussler now that this tunnel is all timbered, instead of being only half timbered.

The quantities given for each one of these tunnels, the quantity of timber, and the quantity of concrete lining, and the quantity of brick work, are obtained from the drawings of these tunels which are shown in the report. For instance, for the Bald Hill Tunnel, on page 17-a, is given a sectional drawing of the Bald Hill Tunnel, which was obtained from the records of the company. Under concrete lining we get a price per yard of \$11.85. That multiplied by .362 cubic yards gives \$4.29 per foot for lining. On the bottom of the page I give an estimate on the cost per thousand of placing brick. On the following page, 17, I compare the cost of lining with brick with the cost of the concrete work.

6659 The estimate develops a price of \$50.29 per thousand for placing the mortar and brick in the tunnel; assuming there are 2 cu. yds. to the thousand brick, it makes a price of \$25.15 per cu. yd. of brick work, and multiplying this price of \$25.15 by the number of cu. yds. of brick, which is .362, we get a price of \$9.11 per foot, which I compare with the price of \$4.29 for concrete lining, on the previous

page, and that makes an extra cost of brick work of $4.82 per foot as compared with concrete lining.

Pilarcitos Tunnel No. 1; a description of the tunnel is given at the top of page 19, giving its length, and the cubic yards of excavation per foot, the backfill, the lumber, and the concrete. The unit costs used are given in the preceding table. The quantities are developed from the sectional drawings shown on page 20-a.

Questioned by Mr. Searls.

My figures as to my quantities I got by taking the drawing and making the computations from it. I did not know that the quantities of excavation for the whole tunnel had been agreed upon. As 6660
to excavation, I have not used any quantity at all. I have just assumed a cost per foot for excavating.

Mr. Lippincott: The figures given by Mr. Dillman, as I have 6661
them, amount to 1.18 per cubic yard. The figures given by Mr. Dockweiler amount to 1.32. The figure I have agrees with the section I have here, and amounts to 1.68. No matter which one it was, I would not change my cost per foot for excavating, my unit price of $12 per foot, because I don't think there is any economy in driving those small tunnels; I have just laid out 11 miles of tunnels, intended to deliver a small amount of water, and I made them 8 feet wide, and 7 feet high.

Questioned by Mr. Searls. 6663

My idea in putting concrete in the backfill was that that is what I thought ought to be done in protecting the lining, and doing it as economically as one could. That is what I have done, myself, in other places.

Questioned by Master.

Referring to page 27, where in calculating my backfill I get $5.67 per cubic yard., and add $1 for plums, and get $6.67 for 2 cu. yds.; that ought to be "plums 1 cubic yard". I would have 1 yard of loose concrete, and 1 yard of plums, costing $6.67 for 2 yards.

In my resume on page 29-a, as to the Peninsula system of tunnels, I take up there the materials in the foregoing pages. The figures in red ink at the bottom are the cost of small tunnels, or 6664
rather, tunnels of small cross-section, that I have used more or less as a guide in making the estimate as to the cost of the Spring Valley tunnel. Immediately above the figures in red, you will see the cost per foot of the Spring Valley tunnels.

The character of the rock at Sunol is different from what it is on the Peninsula. It is a shale. I should expect to find a good deal of swelling ground in there, or heavy ground. The material will drill easily, and shoot reasonably easy, but would have to be handled with a good deal of care to keep it from caving in. The gravel I figure on getting at Niles. The cost of getting it from Niles, screened and assorted, would be about as cheap as hauling it

from the property of the Spring Valley Water Co. One of those tunnels, I think it was Tunnel No. 5, the cut was excavated, and the tunnel section put in there, and then, I understand, a backfill. The cost per foot of Tunnel No. 5 is quite different in the cost per foot from other tunnels at Sunol. That is the explanation of it. On the bottom of page 31 you will see a summary of the cost per foot of those Sunol tunnels, in which Tunnel No. 5 is given at $13 per foot, and Tunnel No. 4 at $29.06 per foot.

Referring to page 30, the July, 1911, cost report, as to gravel: I do not think that is a Spring Valley cost report. It is a Los An-
6665 geles Aqueduct cost report.

Questioned by Mr. Greene.

That is a study of the cost of materials. I have made an estimate on the cost of getting gravel from the property of the Spring Valley Co., at Sunol. Those are different elements that go into the cost. I arrived at a figure of $1.10 for the cost delivered at the portals. I have a note that gravel can be obtained from Niles at this rate if the haul is not over ¼ of a mile. As there are 2 railroads through the canyon, and a good many different sidings, it is my recollection that I used the Niles figures.

Questioned by Master.

The Merced Tunnel is described on page 33. It is my information and understanding, with reference to this tunnel, that a portion of the length of the tunnel was to be driven at an elevation lower than a level of what we call ground water. The formation is a sand; this wet sand, when you are driving a tunnel beneath the water level will run, and it makes a difficult situation to handle. I have had one experience in handling a tunnel of that kind, in which we sank 10 or 12-inch well-pipes ahead of the tunnel, and on the line of the tunnel, and pumped from one well after the other hard enough so as to lower the level of the water below the grade at which the tunnel was being driven. After the tunnel was driven, and the lining placed, the pumping on that particular well ceased, and pumping then was taken up on the next well. In the case of the Merced Tunnel, I assumed that some such plan was followed. I assumed that the surface of the ground was 150 feet above the grade of the tunnel; that these wells were put down 300 feet below the surface of the ground in depth; that 1,000 out of the 3,036 feet of the tunnel is dry on the east end, and 500 feet on the west end, and that
6666 the length of tunnel that would have to be handled by the pumping operation referred to is 1536 lineal feet. I assumed that wells were put down every 50 feet, to an average of 300 feet, or 10,000 feet of well casing, which would cost for the casing 80 cents, for driving $1.20, or a total of $2 a foot for the wells, or $20,000 in all. Then I assumed that these wells were pumped with a 100 H.P. motor, driving an air compressor; that the pumping costs would aggregate

$26,700 in all, including the cost of the wells, or amounting to $8.80 a foot for the entire tunnel.

I arrived at these assumptions by going out there and walking over the tunnel, and seeing the character of the materials, and partly on information I got from the office. I observed, also, along this tunnel, that there were certain of these wells that had been put down. I don't know whether they were actually used for the purpose I have described, but there were wells along the line of that tunnel.

Questioned by Mr. Searls.

When I say "information from the office," I mean statistical information obtained from the draughting room.

Questioned by Master.

Referring to item "excavation $10": I have had experience in sand excavation, and have advisedly made that distinction between $12 here and $12 elsewhere. The driving of tunnels in sand is not an easy matter. If it is done very skilfully, it can be done quickly, and rather cheaply, but if blunders are made, it can become a very 6667
expensive proposition.

The Honda Tunnel was a sand tunnel. That is assumed to be driven for $8.40 per foot, because of the fact that it is above the water level.

Certain photographs of the Sunol galleries, presented by Mr. 6668
Hazen, were received and marked "Plaintiff's Exhibit 134".

Witness: John J. Sharon for Plaintiff. Sharon

DIRECT EXAMINATION BY MR. GREENE.

Referring to the pamphlet which I have before me, entitled "Original costs, so far as ascertainable, of lands, riparian rights, "and rights of way outside of the City of San Francisco, and owned "by the Spring Valley Water Co., dated February 7, 1916": The figures were obtained from all the available data of which we have knowledge, such as the exhibits in the 1902-03 rate case, the Municipal Reports, and statements furnished by Baldwin & Howell, who purchased a lot of lands in Alameda County for the Suburban Co., together with such records as the company's books contain since 1906. This was prepared under my direction. Mr. Bailhache, Jr., was 6669
getting up a similar statement for the City, and our men who made this statement had two conferences with Mr. Bailhache, and I believe that the figures on both this table and the City's table are identical.

The title on the outside of the pamphlet to the effect that this covered only lands and so forth outside of the City of San Francisco, is not entirely accurate. There are no rights of way in San Francisco shown in this table.

This tabulation was introduced and marked "Plaintiff's Exhibit 135".

A tabulation entitled "Joint exhibit, gross reproduction cost of "the distributing pipe system, pipe valves, meters, services and pave- "ments, excluding large wrought iron pipe, and engineering, con- "tingencies, etc., and interest during construction, as of December "31, 1913; Spring Valley Water Co., February 7, 1916," introduced
6670 and marked "Plaintiff's and Defendants' Exhibit 136".

6671 A tabulation entitled "Joint exhibit, gross reproduction cost of "roads, fences, transmission lines, and Ravenswood wells, excluding "engineering, contingencies, etc., and interest during construction, "as of December 31, 1913; Spring Valley Water Co.," received and marked "Plaintiff's and Defendants' Exhibit 137".

Lippincott Witness: J. B. Lippincott for Plaintiff.

6672 DIRECT EXAMINATION BY MR. GREENE.

I find that there have been some rather technical and exact uses of the word overhead by others in this case, and that my definition, either through carelessness or lack of understanding, has not corresponded entirely to that use by others. Mr. Hazen and I have taken the cost report of the aqueduct and endeavored to distribute the expenses which I have referred to as indirect, or auxiliary expenses, so that my distribution of these expenses can be made comparable with those that are understood by Mr. Hazen. In a table which I have here, marked "Comparison of distribution of indirect and "supervision costs of the Los Angeles Aqueduct for work done by "day labor and by contract", we have made such classification as we could. We do not take the position that this is precise, or anything more than a best expression of judgment.

6673 There are two other items I wish to call attention to. The first is purely a matter of expression of personal judgment. It reads as follows: "General city offices: Counsel, Board of Public Works, "Water Commission, City Auditor, City Treasurer, City Attorney, "Chief Engineer, various assistants in the Water Department, through "a period of 8 years, the cost of all of which is not included in the "above figures, $750,000, or $94,000 per annum." That figure was arrived at in this way: I have here a book called "Financial statistics of cities of 1911, Bureau of Census". On page 210 is given a statement for that year of all general departmental expenses for the City of Los Angeles. It amounts to $6,343,002. On an adjoining column is given a figure under the heading of "General Government," $1,123,028. On page 216, opposite No. 15, the City of Los Angeles is given a distribution of the expenses of the General Government, in terms of percentage, as follows: The legislative branch, 1.1%;

executive branch, 9.3%; judicial branch, 4.3%; elections and government buildings, 3%.

Questioned by Mr. Searls.

The figure of 4.7% is based on that census report.

DIRECT EXAMINATION BY MR. GREENE.

That is largely the basis on which these figures were founded. 6674
The process Mr. Hazen and I followed was this: We considered in a somewhat general way what the expense of the executive and administrative portions of the city government would be, excluding judicial, 6675
and we arrived at a figure based very largely on Mr. Hazen's experience. In order to develop that figure further, we examined these census reports, which were available, and confirmed it by these further studies.

(The Master reserved a ruling for the time-being as to whether a census report is entitled to be admitted as prima facie evidence.)

Mr. Lippincott: I took the four years, 1908, 1909, 1910 and 1911, and I found that the expense of all departments for all those four years for the City of Los Angeles averaged $4,622,000, and that 6676
the general governmental branches averaged $653,569. Of this figure, according to this authority, the legislative, executive, elections and buildings, comprise 76%, which would indicate an outlay for those three departments of $497,000 a year on the average. The figure that Mr. Hazen and I arrived at before using this census data was a charge of $94,000 a year; that amounts to 19% of the cost of the city administration for legislative, executive, elections and buildings.

The expenditures for the Los Angeles Aqueduct that period somewhat approximated, or perhaps about equalled in amount, the expenditures of these other branches of the city government, and I drew the deduction from that that this charge of $94,000 a year for these general governmental expenses was a reasonable percentage to use.

Questioned by Mr. Searls.

Mr. Hazen and I had previously arrived at a figure of $94,000 a year, which we thought might be a reasonable charge, and that $94,000 a year would be 19% of the expenditures by the City of Los Angeles for the legislative, executive, elections and building departments of the city government. That relates to that item of 4.7%.

I want to explain in relation to the cement mill. When we began 6677
operating the cement mill, we made an estimate on the cost of production of a barrel of cement. This cement was issued to the various pieces of work at a fixed estimated cost per barrel. After the completion of the entire enterprise, there was an indicated book loss on account of this cement mill operation, of about $890,000. That figure has not been distributed over any of this cost data that has been presented relative to the unit costs on the aqueduct work. It seems

to me that really the proper way of handling that would have been to specifically charge that out to the various work orders, or pieces of work. That has not been done. That would amount to 5.55% on the actual cost of the waterway, which has been described as a direct cost of the aqueduct. In this tabulation which is presented here, it is added as an indirect expense under my estimate, and under Mr. Hazen's tabulation it has been included as a construction cost.

Mr. Hazen: I approached it from a little different standpoint than what Mr. Lippincott did. From experience on other large works, I should say that the administration expense represented by these
6678 city officers, outside of the engineering, would reasonably amount to at least 2% of the whole amount expended. Mr. Mulholland's salary, and the services of his assistant, that were not charged to other things contributed by the Los Angeles Water Department, might reasonably amount to 1%. That would make 3% altogether. Now, the 4.7% that Mr. Lippincott reached in another way amounts to ¼% of the whole expenditure, approximately, so that that checked pretty well with my judgment, based on an entirely different method of approach. The only interest I have in knowing the total expenditure of the city per annum was to put something up against this $94,000, and to see if the $94,000 seemed reasonable, in view of the total expenditures for those purposes, by the city.

Questioned by Master.

The work that I have in mind particularly as a basis for the 2% is public work, such as has been done by separate commissions, like the Water Board in New York, and the Metropolitan Water Board that built the waterworks for Boston and surrounding cities. I have no reason to think that that cost would be materially different from a private corporation.

6679 Questioned by Mr. Searls.

Mr. Hazen: I do not think that municipal officers are paid larger salaries than are the officers of private corporations, but there are a great many more of them.

Questioned by Mr. Greene.

Mr. Hazen: The supervision for this work, as we figured it, adds up 17.38% of the direct cost. The cost of construction is made up of 100% of direct cost, and 26.64% of indirect costs, classified to construction; the 17.38 amounts to 13.7% of the whole construction,
6680 being the 100% and the 26%.

Questioned by Master.

Mr. Lippincott: It is my understanding of this analysis, that to my estimate should be added this 10% for supervision, which perhaps sometime has been referred to as overhead; according to Mr. Hazen's estimate, he would put these indirect charges under the column marked "Construction," which is column 4, and then his

supervision would amount to 13.7% of all the construction charges, which would include those shown in column 4, as well as the direct estimate.

Questioned by Master.

Mr. Hazen: In comparing any of my figures that I have given, independent of this matter of indirect or overhead, my method is by contract, and Mr. Lippincott's is by day labor, but my thought on that is that normally the contractor has to do the work enough cheaper than it could otherwise be done for by day labor, and make his profit; if he cannot do that, there is no use of following the contract system.

Questioned by Master. 6681

Mr. Lippincott: Referring to sheet marked "Schedule of comparative costs"; Mr. Hazen's total is $41,113, and my total is $40,828. It is my understanding that Mr. Hazen would take his figure and add 13.7%, as deduced from the Los Angeles Aqueduct, but that he would use 15% as deduced from other things. Taking those Los Angeles Aqueduct tunnels, which I think are rather low for expenses of that kind, I would add 10%.

DIRECT EXAMINATION BY MR. GREENE. 6682

When I stated that Mr. Hazen would add 15%, and that I would add 10%, my purpose was simply to use this as an illustration, and not as a conclusion.

Questioned by Master.

In my appraisals in this case I have not made the final overhead addition; I have simply given what I understood as direct and indirect expenses.

Mr. Lippincott: Mr. Hazen, first, from certain experience that 6684 he has had, came to the conclusion that a figure of about $94,000 a year might be charged for the general administrative expenses of the city against the building of the aqueduct. Now, I take that up to see whether that sounds reasonable on the basis of what the actual expenses of the city were for executive, legislative, elections and buildings, during this period of four years for which I had the record. Now, the $94,000 for that period averaged 19% of the total expenditures of those departments of the city's government. On Mr. Hazen's authority to assume $94,000 as the proportional expense, I found out what the total expenditure for the city government was, and I determined a percentage of 19%, and then determined in my own mind whether 19% sounded reasonable.

A study of Los Angeles Aqueduct admitted and marked "Plain- "tiff's Exhibit 138".

(Certain corrections noted in the record by the witness, Mr. Lippincott, in his previous testimony.) 6685-6690

6690 DIRECT EXAMINATION BY MR. GREENE.

When I said an 8 x 8 ft. tunnel, I meant that is the exterior line of the tunnel, and is the total dimensions of the excavated section. The timbering, lining, and the concrete lining, would both come after that.

6691 Witness: ALLEN HAZEN for Plaintiff.

Hazen DIRECT EXAMINATION BY MR. GREENE.

I have here a schedule of the estimated reproduction cost of tunnels, and some copies of sheets from my note book, showing some of the more important processes by which these figures were reached, and supporting data of the cost of certain other tunnels.

Introduced and marked "Plaintiff's Exhibit 139".

The tunnels of the Spring Valley system are nearly all small lined tunnels; some of them are lined with brick, and some with concrete. Very few tunnels of this description have been driven in California in recent years, and it has been particularly difficult to get an adequate and satisfactory basis for estimating the cost of reproduction for these tunnels. I have used, principally, such data as I could get as to actual things that happened on the Spring Valley tunnels, especially the more recent ones, and experience and records of cost of eastern tunnels, which have been driven in much larger numbers, and which are comparable. I have designed and supervised the construction of one tunnel, about a mile long, coming in this class, the tunnel being a little less than 6 feet in diameter, and lined with concrete throughout, and a few short tunnels in connection with other works. Railroad tunnels have been driven in California, but they throw very little light upon the cost of driving tunnels of this class, because a railroad tunnel is so much larger, and the method of driving it is different, and the cost per cubic yard is very much greater, as the space in which the work is done is smaller. Many un-
6692 lined tunnels have been driven, but the records of cost of such tunnels also are of little use, because when a tunnel is lined, and it is necessary to line a tunnel for waterworks purposes, where the rock is as soft as that around San Francisco, the cost of the driving and lining are tied up with each other, so that an estimate of either without the other is not of much use. The economical way of cutting through, as far as the driving alone is concerned, is to blow out a good sized hole and push it ahead, and get the material out, so tunnels can be driven in that way for a figure which is comparatively low. When it comes to lining a tunnel which is driven cheaply in that way, it is necessary, not only to place the lining, but to fill up the space between the lining and the rock on the outside, to prevent against subsequent trouble with movement or settlement of the rock, so if

the tunnel is cheaply driven, it costs a great deal to line. On the other hand, if the work is in the hands of someone who has done it before, and understands the business, the driving will be done more slowly, and at a much greater expense, but with the result that a hole is produced that fits the lining throughout closely, and then the lining can be done economically, and the whole cost, probably, will be less than it would have been if the work had gone faster, and the driving had been done more cheaply; for that reason, records of cost of lining, or of driving, by themselves, I do not consider of very much service in this connection.

I have divided the construction of the Spring Valley into several periods. There were five tunnels built prior to 1880. The diameter that I have used is always the diameter of a circle of equal area; that is the system that I have used for some years for classifying tunnels, and it seems to be the best way of handling data of this kind, and I have used approximate figures. I have not attempted to get a third decimal place, or any great refinement in the calculation. The cost per foot, according to the old records, I have also entered. These figures I 6693
had mostly—perhaps entirely—from Mr. Sharon. These five early tunnels averaged 3.9 feet in diameter, and including the tunnel, the record of which is inaccurate, cost neary $19 per lineal foot to drive many years ago. The size of the tunnels has steadily increased, and practically in the whole Spring Valley system every tunnel driven has been a little bigger than those that have gone before, indicating, I think, that the tunnels first driven were below the economical size, and that it was found easier, and perhaps cheaper, to drive a somewhat larger tunnel. Most of these tunnels have a carrying capacity in excess of what is required, so that it must have been primarily a question of selecting a size that would be most economically driven, rather than the size that would give the required carrying capacity.

These early tunnels, I expect, were drifted through by hand work, with comparatively little explosive, and the cutting was done quite accurately for the desired section, and afterward they were lined up by brick. I do not think it would be possible to get men to build tunnels of these sizes in that way at the present time. I have never known of any tunnels being built in a corresponding way. I have seen old tunnels in other places, corresponding to these, that were built, but to build them means that men would have to work in a cramped, uncomfortable position, and I do not think that the workmen we have had on work in recent years could be gotten, as a practical proposition, to build work of this kind. It may be that it would be possible to find a few men, if you were on the lookout 6694
for them, that would be willing to work in these. I will not say it could not be done, but I should not dare count on its being done.

In the second period, I have included only one tunnel; the

Crystal Springs No. 2, built in 1885; it was 4½ feet in diameter, and was quite a little larger than any that had gone before, and I don't know what it cost. There was another tunnel 301 feet long built at the same time, but that is not comparable with the others, because the pipe was laid in it, and the space between the excavation and the iron was bricked up. The same may be said of the Bernal Tunnel in the city, which was built in the same way.

6695 The third period was from 1897 to 1900, when three tunnels were driven. The Stone Dam Tunnel first, 4.7 feet in diameter; the Davis Tunnel in 1898, 4.9 feet in diameter; and the Sunol Tunnel in 1900, 5.7 feet in diameter. These tunnels were concrete lined, and were driven and built in pretty much the method that would be used at the present time. In this period the ordinary wages of laborers, including board, ranged from \$1.65 to \$1.90 for an 8-hour day; miners received \$2.50 per day, and carpenters \$3 to \$3.75 a day. Those figures I have from Mr. Lawrence's notes. The present rates of wages are from 40 to 50 percent higher; in addition, insurance and payrolls for driving must be paid; perhaps that might not be true of the period for which the tunnels would have been built to have been useful in this rate case. In so far as that is the case, I think perhaps that statement might be withdrawn, but in connection therewith it seems to me that paying insurance on a payroll is not an added cost of driving. It is simply a transfer of risk which formerly existed and was carried by the contractor, or by the principal, in case it was done by day labor, to the insurance company, and of course the amount that is paid as insurance may be more or less than the fair value of the risk, but there is a presumption that it is more or less equivalent to it, and it takes the place of a risk that formerly existed. I regard that as another way of doing business, and not as an increase in the cost of doing the work.

Questioned by Mr. Searls.

6696 On one tunnel which I designed and supervised four or five men were killed, and that involved an expense to the contractor which was a very substantial one, and which this liability insurance takes the place of, or is intended to take the place of. It may be that there is some new element of risk included in the compensation act that went into effect in California, and that the new law provides greater compensation than could be demanded under the old.

DIRECT EXAMINATION BY MR. GREENE.

6697 For the tunnels we had in this period, Mr. Lawrence was able to give me some records of cost, and I went over these to see what use I could make of them. I have not heard his testimony, nor examined what he said as to those. This is what I got from him a year and a half ago. On the Stone Dam Aqueduct Tunnel the payroll for driving was \$20,588, equal to \$5.85 per foot; the lining was

equal to $5.75 per foot. I made an estimate for the material and auxiliary cost, taking the $5.85 per foot, and adding the increased rate of wages—I am not sure whether I calculated that with Mr. Lawrence—but adding 40%, the cost would amount to $8.20 per foot, and with the insurance, I increased that to $10 per foot. For the lining, with the 40% addition, without any allowance for risk, because the lining is much less hazardous work, $8 per foot. The lumber, explosives, concrete, material, ventilators, etc., I estimated, and that amounts to $27.45 per foot. That does not include the auxiliary expense, or the road construction, which was rather heavy in this case, or the cost of the camps and so forth. That is simply using that fragment of information for what it is worth, and attempting to apply it to present conditions. I understand that is the actual price.

Mr. Ellis: I have just referred to Mr. Lawrence's exhibit: He gets a resolved cost of $23 after he resolves his 1913 figures. I mean puts his Buckman contract at $7.50 a foot.

Mr. Hazen: I don't think I can straighten that out. $10,186 is 6698
the amount of the contract for the Davis Tunnel.

Questioned by Mr. Dillman.

Hazen: The Buckman contract was for driving, and the payroll was principally for lining. The rest of it, it seems to me, was something done for Buckman. I could not tell the details of that. This is what I got from Mr. Lawrence at the time. If he found something subsequently, why you will have to find out about that. The tunnel labor cost was $19.15 per foot; that includes the Buckman contract. At present prices, 45% would be added, or $8.60 per foot. There would be some reduction in the cost of cement and supplies, and as an adjustment for present conditions, I thought on the basis of the old records the added cost at the present time would be about $7 per foot, and adding that to the $26.84, using round numbers, gives $34 per foot as the approximate present price of driving that, based on the old records.

On the Sunol Aqueduct, the word "Tunnel" in the agreed 6699
schedule, is used to include both tunnels, and a considerable length of cut and cover, aqueduct built in connection with them, and which cost much less per foot than the tunnel. What I actually did was to find out as nearly as I could what was tunnel, and what was cut and cover, and estimate the tunnel as tunnel, and the cut and cover as cut and cover, and the prices which I have written into the schedule I have made up by a combination of the two estimates, which accounts for the varying prices per foot for the different sections of the Sunol Aqueduct. Mr. Lawrence's notes show the labor cost of drifting at $6.02 per foot, but that is not of much significance, because of this same fact of the mixing up of the open cuts and tunnel work, and I think this represents a certain labor cost, per-

haps the excavation of the open cut and the cost of drifting. As the rest of the record is not available, or was not available to me, that practically does not have any bearing.

The fourth period, the Sunol Tunnel No. 2, was built in 1908, a short tunnel 856 feet long, and 6.2 feet in diameter, the size still growing. That was built at the time of the construction of the Western Pacific Railroad, when the railroad necessitated a change in the location of the aqueduct, and this tunnel was built in connection with that, and the cost of that tunnel, as I have it from Mr. Lawrence, was, of the drifting done by contract $9, and in addition the contractor was furnished with the timber, which cost $2.06 per foot, and the labor in lining the tunnel cost $9.20 per foot, and the concrete and other materials cost $7.62 per foot, making a total
6700 cost to the company of $27.88 per foot. That was done pretty nearly at present prices for labor, $2.50 for 8 hours, and most of the work was done by labor paid at that rate. Mr. Lawrence did not have the actual payments of the company for the completed work, so the actual cost might have been a little above this, although that is believed to represent the greater part of the construction. There was a little discrepancy in the length, which I did not attempt to adjust.

The Merced Tunnel is not included with the others. It was built for drainage purposes through sand, and it is not comparable. I thought, when I made this estimate, that probably the most advantageous way of driving the Merced Tunnel, if it were to be built today under present conditions, would be by the use of compressed air to keep the water out, but it was not actually built that way, and I think that Mr. Lippincott's estimate was not based on that, so I may be in error as to that assumption. This tunnel was drained for construction, and the drain remains, and its presence has served to drain the land in its neighborhood, so that it is probably in fairly dry country at the present time, but I understand that when it was built the ground level was higher, and so it was a wet piece of work, and to drive a tunnel through wet sand is exceedingly difficult business. The estimate for the Merced Tunnel is not quite in line, as of course it would not logically be, with the estimate for the other tunnels.

Questioned by Mr. Searls.

That was just a general estimate, based on studies and information as to the cost of other sand tunnels in other places. I did not go into that in much detail, because that is one of the hardest things to
6701 estimate that there is. If it is well handled, it may be put through rapidly and at moderate cost, but if anything happens, there is nothing where the costs will duplicate and quadruple faster than they will in a tunnel in wet sand. The element of risk is very large, and I do not know of any way that a close estimate can be made for a structure of that kind.

In addition to this Spring Valley information, I have included

the cost of the Los Angeles Aqueduct tunnels. They, in general, were equal to a circle of a diameter of 8.3 feet. Mr. Lippincott got this figure for me, which appears under the heading "Tunnels on Los Angeles "Aqueduct". He figured the average cost of the tunnels on the aqueduct at $36.55 per foot, which includes engineering and executive supervision; most of the costs that come into the statement that Mr. Lippincott and I prepared together, and which has just been presented, include all the items, except the two that were omitted, namely, the general expense of the city government, and the proportion of cost of the cement, which was not brought into that calculation. Those two items, I suppose, would bring this to perhaps between $39 and $40 per foot. That is of less significance than it otherwise would be, because the diameter of the tunnel is so much greater than the diameter of the Spring Valley tunnels.

A few years ago I had occasion to make estimates for some small tunnels, comparable to these, for the City of Pittsburg, and in connection with that, one of my partners looked over the ground, and found only comparable tunnels that had been driven within a few years, and to get what information about them could be secured, and
quite a memoranda was made out relating to those small tunnels, and 6702
their cost and difficulties. I took that as a basis when I made this estimate a year and a half ago, adding a few other items of tunnels that have been driven in the interval that I knew about, to see how this data could be applied to the Spring Valley tunnels.

Questioned by Mr. Searls.

I have not personally seen all of these tunnels, but a majority of them I have seen.

Mr. Ellis: The Brunton and Davis Tunnels are largely mining
tunnels. Brunton and Davis were two of the representatives of the 6704
Bureau of Mines, who made a very exhaustive examination of all small section tunnels, and published the results of their first inquiries in a Bulletin of the Bureau of Mines, and they have recently issued a book called "Modern Tunneling" that takes in a number of mining tunnels, drainage tunnels, water tunnels, and so on. They have covered in their examination, up to date, I believe, as many small tunnel sections of the country as they could gather. They are not all mining tunnels; a great many are water tunnels. They have a number of the Los Angeles Aqueduct tunnels, and Mr. Lippincott's
Santa Barbara tunnels. It is stated with great detail as to how the 6705
work was done, the number of muckers, etc.; it is a very exhaustive examination. Apparently it was done under the direction of the Government.

(It is stipulated that the statement made by Mr. Greene as to 6705-6706
the measurements from San Mateo to the dam, and to the crest of the dam, is correct. That is to say, that Mr. Lawrence would so testify if he were here.)

NINETY-THIRD HEARING. FEBRUARY 9, 1916.

Witnesses: ALLEN HAZEN for Plaintiff.
J. H. DOCKWEILER for Defendants.

6707 DIRECT EXAMINATION BY MR. GREENE.

Hazen The Little River Tunnel, driven under my own direction, is the only tunnel that I think is comparable with the tunnels in this system. I have had to do with other tunnels, and have driven some other tunnels which I think are not comparable to the tunnels in this system. I have acted as consulting engineer for works where tunnels were driven, and have made estimates for tunnels, and have studied and been somewhat familiar in a general way with tunnel conditions and
6708 costs. Tunnels of this kind are not driven every day. The total number of them in the United States, comparable to these tunnels, is comparatively limited, and it would not have occurred to anyone in ordinary general practice to have driven a large number of them. Perhaps 5 years ago I made estimates for some tunels in this neighborhood for a client, and in connection therewith made a study of tunneling conditions, and costs, in this neighborhood, getting such data as I was able to at that time, from such people as Mr. Manson, Mr. Connick, and Mr. Ransom, and others. That was followed up when this study for the Spring Valley Water Co. was made by further inquiry, and getting such further information as could be obtained. My client in that case was the City of San Francisco.

The agreed schedule shows a certain length of tunnel in the Sunol Aqueduct. When I took it up I supposed that it was a tunnel, but when I came to walk the line, I found that parts of it in reality were cut and covered aqueduct, and I disregarded the schedule where that was the fact, and estimated the cost of building it at the present time as well as I could in the way that it is, and not in the way that it was represented in the schedule. I went through yesterday approximately to see what difference it would make, and on the Sunol Aqueduct alone my estimate is $73,000 less than it would be
6709 if I followed the schedule. The same applies to several tunnels which are noted on the first page of Exhibit 139, but I made this calculation for the Sunol Tunnel only. The $73,000 is the largest item of difference, but there would be several others of smaller ones.

6709-6710 (The Master here stated that where there was a question of divergence from the schedule that it is desirable that the fact should be taken as it exists if it can be determined, but if there is any question about it, the parties must be bound by the stipulated inventory. He thought Mr. Hazen's treatment of this subject of the Sunol Tunnels to be entirely proper.)

Mr. Hazen: Referring to Exhibit 139, the portion headed "Cost "of eastern tunnels"; this was a list of all the tunnels that I knew about that were close to the conditions presented in this case, so that I thought they could fairly be helpful as a basis of comparison. An inquiry was made by a man in my office, under my direction, as to the conditions of every one of these, and of their cost. I am personally familiar, more or less, with the majority of them, but I am not very 6711
familiar with but a few of them. I could not attempt, from personal knowledge, to tell you all about most of these lands.

The Cleveland land tunnel I never went through. I did go through the water tunnel connected with it, and which was driven at the same time.

The Boston sewer tunnels were partly of the Metropolitan sewerage system. I was familiar with that work, and with the country, etc., but I was not particularly familiar with the tunnels and with the driving of them.

The Cincinnati water tunnel I knew about. I knew the chief engineer and went through it with him; not professionally, but as a visitor before it was built, but I did not go through it during construction.

The Little River Tunnel was our own work.

The Boston water tunnel was the same as the Boston sewer tunnel, and was built by the Metropolitan Water Board. I was generally familiar with it, and acted as consulting engineer for the Board on other matters, but I did not have personal contact with that tunnel.

The Vicksburg sewer tunnel is some of Mr. Metcalf's work, and I took that item from him.

The tunnel at Hartford, Conn., is a tunnel I laid out and made an estimate for, but it was not built under my direction.

This first list contains the ones that I selected as being more directly helpful in this discussion. It is followed by a second list which is less directly applicable, and then by a third list which is still more remote, and then by a fourth list of tunnels through softer materials, which we put in another classification, and which I thought also was helpful in a very general way. 6712

To take up the second list, the Toronto water tunnel I went through in the course of construction, and am somewhat familiar with what happened there. I was somewhat familiar with the conditions of the other tunnels when they were built, but I did not go through any of them. The last three are tunnels of the new board of water supply work, in New York, for which I am one of the consulting engineers, but my duties have not had to do particularly with these tunnels.

Of the following lists, I think I have not been through any of the tunnels during construction. The application of all of this data to the present case is somewhat difficult; the conditions are so different that it cannot be directly applied, and I have not attempted to apply it. I simply put it in as a background to the general experience that I knew something about, and as one of the things that I had in mind when I made the estimates.

With reference to the tunnels on the first page: The Cleveland land tunnel we had from official reports of the City of Cleveland. The Boston sewer tunnels, of which there are three, we had the records from Mr. Brown, who was chief engineer of the work. The Cincinnati water tunnel is a part of the new Cincinnati Waterworks con-
6713 struction, of which I have made something of an analysis. The cost of that work was kept very carefully; it was done by a separate board, so that there was no mixing of the finances with the general city finances, and the money was all accounted for, and the financial statement made upon the completion of the work, which was published and distributed, is remarkably complete. The Little River work I handled directly. The Vicksburg sewer work I took Mr. Metcalf's statement for. The Hartford Tunnel I laid out originally, and estimated the cost of, and my information as to cost was obtained from a personal letter from the engineer of the work, which I received a few months ago.

Questioned by Mr. Searls.

I have not intended to say that these tunnels are directly comparable with the Spring Valley tunnels as to the character of formation, the difficulty of driving, and so forth. I have intended to say the other thing; there are a great many differences, and I have not attempted to adjust those differences for the individual tunnels.

6714 Questioned by Master.

Referring to the tunnels mentioned on the first page; this list comprises all the tunnels that I know of, less than 8 feet in diameter, driven since 1900 in the United States, that are completely lined. While the conditions of the different tunnels have been very different, and while none of them are just like the conditions in the Spring Valley system, and while I don't think the cost of the Spring Valley tunnels could be computed directly from these costs, I do think that with this information the knowledge that these tunnels have been driven, and that they cost the figures written opposite them, which represents the cost as nearly as I could get at it from careful inquiry, is something that undoubtedly influenced my judgment in making the estimates, and I thought it was proper to let you know what I have.

Questioned by Mr. Searls.

Obviously, a condition where you had a tunnel driven through very hard rock, where you had to do a great deal of shooting, and the expense was very materially increased, would not be directly com- 6715
parable to a tunnel which you would have to dig in a relatively soft formation where you had to do very little shooting in a great portion of the work, and where the whole work would be done in a very different way, and by different methods. Hardness of rock, in itself, I should say made a good deal less difference with the cost of tunneling than one would suppose who had not studied it. The way the rock breaks makes more difference with the cost of tunneling than the hardness of the rock. The hardest rock that we have is trap. Tunnels have been driven through trap rock at less cost than they have been driven through softer rock, because the trap shoots well, and oftentimes it is in formations that break well, but taking it right through, the eastern tunnels in this list are not much harder rock than the tunnels on the Spring Valley system, and while I do not think that makes as wide a difference as some might think, it does make a substantial difference. The tunneling in this neighborhood is cheaper, other things being equal. The principal cost of tunneling, probably 60% of the total cost of a tunnel, approximately is labor cost, and the labor cost in the San Francisco district is a great deal higher than the labor cost has been for these eastern tunnels. Those are the most important points of difference. Of course, there are other differences. The tunnels in this list represent by no means uniform conditions; they represent a wide variety of conditions.

(Counsel for Defendants here stated that in view of the state- 6715-6717
ment that the witness had made this morning he would withdraw the objection as to the admission of this testimony, as he thinks the evidence is proper, as showing a part of the witness's experience in general in tunnel work. He is not going to object to any information Mr. Hazen has, whether he got it from a text book or anywhere else, as part of his education in tunneling. This withdrawal is to apply to the first set of tables.)

Mr. Hazen: The second two groups I would give comparatively little weight to. I think they substantiate the data in the first; also in regard to the figures on the bottom of page 2, and page 3, I was 6718
not familiar with the exact character of the work done, or the localities through which they went. The one on page 3 shows tunnels, and data for tunnels, through much softer materials. That is not through rock. It shows a considerably lower price. That is not applicable to the Spring Valley conditions, but I thought it threw a little light on it as tending to show the cost of tunneling through very much softer materials.

Questioned by Mr. Searls.

The Chicago tunnels—five of them—I don't think I went through any of these identical tunnels, but I have been through other tunnels in Chicago in the same formation, and have seen the driving, and know what the conditions are. The reason that the tunnels I have been through are not in this list is because they are larger, and this was limited to tunnels small enough to be comparable. The same is true of Milwaukee: I didn't go through that identical tunnel, but I have been through other tunnels in the same neighborhood in Milwaukee. The Boston sewer tunnel I have no personal familiarity with, and the one at Sioux City, Iowa, I have no personal familiarity with.

(Counsel for Defendants stated that as a part of Mr. Hazen's
6719 general information, he has no objection to those being admitted.)

Mr. Hazen: My estimates are based upon $35 per foot for a lined tunnel, complete, through rock, in the neighborhood of San Francisco, with a diameter of 6 feet. That is a tunnel having an area inside the lining equal to the area of a 6-foot circle. I took that as a starting point because of these small tunnels. I have been in the habit, for a long time, of taking the costs for a 6-foot tunnel as a starting point, and then applying ratios to represent the cost of other tunnels, the size, of course, differing not too much from 6 feet. A 6-foot tunnel would not be a good starting point for estimating the cost of a 12-foot tunnel, but for tunnels ranging from 4 feet to 8 feet, I think it is a good starting point, and I have used it in that way. The most economical tunnel to drive, regardless of size, would be, I think, somewhere between 5 and 6 feet. The Spring Valley tunnels are mostly under 6 feet. As a matter of judgment, with a 6-foot tunnel, driven for $35 per foot, a 5-foot tunnel could be driven for about $30 per foot. I don't think that small tunnels at the present time, with the present labor, could be driven any cheaper, or perhaps as cheaply, as a 5-foot tunnel. If this work was being laid out, I don't think that anyone would definitely propose tunnels less than 5 feet in diameter. I mean by that, tunnels 5 feet in the clear of its finished work, and
6720 reckoned as the diameter of a circle of equal area. I followed that system because these tunnels varied greatly in shape, and it seemed to me that the diameter of a circle of equal area was the fairest way of computing them.

Questioned by Mr. Greene.

The finished work, with the lining in, calls for an excavation perhaps 7 feet square, or a little more than that in the rough work. Many of the Spring Valley tunnels are less than 5 feet in diameter. I adopted, perhaps, an arbitrary procedure in estimating them; I thought they ought to be estimated a little less than the 5-foot tunnel, even though they could not be driven for any less money at the present time. For the smaller tunnels I cut the $30 figure a little,

and for a 4-foot tunnel estimated $27, and for a 3-foot tunnel, $25. In applying these to the tunnels of the system, I just found out, approximately, what the diameter was, and then interpolated between these figures. The figures which are used are shown on the first page of this exhibit, with the length and the amount.

In considering the reasonableness of these estimates, the early small tunnels driven from 1868 to 1872, five of them, show an average cost of $18.94 per foot, but that, I think, is below the true cost, because in one case it seemed to me the reported cost was a part of the cost, and not the whole cost, and so that figure, I think, should be increased; how much it should be increased, I do not know; I think $20 would be more nearly the actual cost.

For these tunnels I now estimate the cost of reproduction from $26 to $27.50 per foot, depending upon their size, and averaging about $27, an advance of 43% over the $18.94, the reputed actual cost, an increase which seems to me reasonable, in view of the change in labor conditions in the long time since these tunnels were built. I do not 6721
know much about the labor conditions of 1870, and I don't attach any particular significance to it, except that it does not seem unreasonable to me that there should be that difference.

For the Stone Dam No. 2 an estimated cost of reproduction at the present time, based on Mr. Lawrence's old labor costs, with present rates of wages applied, and with my own estimate for those items of construction which Mr. Lawrence did not have, amounts to $27.45 per foot. That is a combination of old records and estimate, and perhaps the estimate predominates, but the labor cost seems to be right, and the labor cost is the largest and most uncertain element of cost in driving a tunnel of this kind, so that I think this estimate is in somewhat different class from an estimate that is made up entirely from new material.

Questioned by Mr. Searls.

Of that $27.45, labor costs make up $18.

DIRECT EXAMINATION BY MR. GREENE.

For this tunnel I estimated $29. In other words, my estimate was above this indication by $1.55 per foot.

For the Davis Tunnel the actual cost is reported at $26.84. I think I was wrong in stating, day before yesterday, that I had this information from Mr. Lawrence, as I think it came from Mr. Sharon. I found the sheet which I had from him, and which I understand is made up from some report made by the company to the City, years ago, and which Mr. Sharon believes to be reliable. The lower part of the sheet follows the calculation which I made, and which is my own, showing the classification of these figures, and the way that I arrived at that price per foot. The sheet referred to is as follows:

CONSTRUCTION EXPENSES—Continued.

1897			1898			1899		
5. Davis Tunnel		$20,396.78	5. Davis Tunnel		$ 8,453.29	Davis Tunnel		$3,437.01
Labor	$ 5,778.00		Labor	$3,370.00		Labor	$1,379.50	
Buckman on contract	9,376.00		Buckman on contract	810.00		....	....	
Cement	2,484.00		Cement	1,800.00		....	....	
Lumber	923.00		Lumber	700.00		Lumber	759.50	
Provisions	780.00		Provisions	478.00		Provisions	1,034.50	
Freight and hauling	416.00		Freight and hauling	453.00		....	....	
Hardware and iron	......		Hardware & Iron, Sand, Oil, etc.	454.00		Pipe, Hardware, etc.	....	
	$19,757.00			$8,065.00				
		$20,396.78			$ 8,453.29			$3,437.01
					3,437.01			
					20,396.78			
					$32,287.08			

Cost per ft., $32,287 ÷ 1205′ = $26.80

		Per Ft.
Labor, including provisions	$12,820	$10.70
Buckman contract	10,186	8.45
Cement	4,284	3.55
Lumber	2,382	1.98
Hauling	869	0.72
Iron	454	0.37
Not classified	1,283	1.07
	$32,278	$26.80

= 4.9′ circle in net area/

In connection with that the cost of drifting was under the contract 6723
$7.50 a foot, plus lumber. The lumber I have added in this statement as part of the cost of drifting. I think that explains the apparent discrepancies that Mr. Searls asked me about.

The $26.84 per foot is the actual cost as we have it. The present rate of wages is about 45% higher than the wages at that time, which is a figure I reached by approximate methods when I first went over this with Mr. Lawrence. Making the adjustment, and deducting something for the lower price of cement at the present time, I estimate roughly that on that record brought up to date about $7 per foot would be added, bringing it to about $34 per foot as a round figure. For that particular tunnel I have estimated $30 per foot; in other words I am $4 per foot under this estimate brought up to date.

On the Sunol No. 2, which was driven in connection with the Western Pacific Railroad changes, the prices of labor and materials come within the period under discussion, and I take that as representing present conditions. The actual cost of that appears to be $27.88 per foot. I say ''appears to be'', because it is not quite clear to me that all the expenses of driving that tunnel were included in that statement; at any rate, that covers all expenses for which a record was found, and whether it is all, or somewhat less than all, I don't know. My estimate for that is $31 per foot, or $3.12 above this figure.

I am going to make now a comparison with the Little River Tunnel, which cost, done under contract, $29 a foot, somewhat less
than my estimate. In my judgment, if that tunnel were to be driven 6724
at the present time just where it is, a fair price for it would be $35 per foot. I was thinking of 1915 when I said ''now'', or perhaps just before the war, not reflecting any war conditions, but the conditions just before that. The $29 was hardly an adequate price for that work, even at the time it was done. The tendency has been for the cost of construction to go up. I think about 60% of that is labor costs. That is an approximation. Taking the base rate of wages, 31 cents per hour here, and 20 cents per hour—the rate that was being actually paid at the time this tunnel was driven, adding eleven-twentieths of 60%, amounts to $9.60 as the added labor cost in the San Francisco district, as compared with the labor cost in Massachusetts. Adding that to $29 brings us to $38.60 per foot. This tunnel was 5.9 feet in diameter. At the rate of estimate which I used for the Spring Valley tunnels, my estimate for a tunnel of this size would be $34.50, or $4.10 less than the adjusted cost of the Little River Tunnel. Excluding all the other information that I gave some weight to in the original estimate, I have four items that I have just mentioned, in two of which I have been above, and in two of which I have been below, and averaging the four I am 86 cents per foot below the indications of the four points. This Little River Tunnel was driven through mica and schist, not a very hard rock, under quite

favorable conditions of work. The $29 is the contract price for the straight tunnel work only; that does not include the approaches, or the road which was necessary to make the remote end accessible, and
6725 various other matters of construction, which, without overhead would have added in that case, I should think, at least $2 or $3 per foot to the whole cost of the tunnel.

I made a correction of $9.60 for the added labor cost, paying $2.50 a day for 8 hours of common labor, but I have made no addition for any other condition. In my judgment the $29 was less than a normal price, less than a fair price, less than a price that adequately compensated everyone who had to do with it, and yielded a fair profit to the contractor in view of the risks that he took in driving the tunnel. If I were estimating the work over again, after having had the experience of driving it, I would estimate $35 a foot as a fair price for the Little River Tunnel work.

Questioned by Master.

In the Little River Tunnel work the contractor had to give up the job. He was a man who had not done contracting before in his own name. He had been working with another man, and had the very highest references, and he had had ample experience in this kind of work, and he seemed well qualified to carry it out. He made financial arrangements that seemed to give him ample capital. He started out with the work, and drove perhaps half of it—the tunnel was just a mile long—and then there was an accident by which the ventilating machinery failed to act on one occasion, and the men went in to the heading too quick, and 4 or 5 men lost their lives, and
6726 that, together with other matters, upset him so that he was unable to go ahead with the work, and we took it over and finished it. The rock, as eastern rocks go, is not very hard rock, but I think it is harder than the rock of the Spring Valley tunnels. I don't cite it as an exact comparison, but it is entirely within my own experience, and actually influenced my estimate to a considerable extent.

As to why I adopted a figure higher than the indicated cost of Sunol No. 2, $27.88; I had some indications that were higher, and some that were lower, and I took a figure that seemed to me at the time to be midway between the indications. I am not sure that that $27.88 is the whole cost. That does not come from any record of the company at the company's office. I inquired for all the data they had, but I did not succeed in getting it. This is made up from notes that Mr. Lawrence had at Millbrae, and I was satisfied that the notes that he had on these different pieces of work frequently did not include all the items of expense. I looked on his records as notes that he made of items of expense that he knew about, but not as conclusive evidence of the whole cost of work, which could only be furnished from the accounting end, and Mr. Lawrence did not have
6727 access to that, so I am not at all sure that that is the whole real cost

of the work. Further, that was rather a short tunnel, and while I have made no difference here—the difference is not a radical one—there is a tendency for tunnels as short as this to cost somewhat less per foot than the longer tunnels.

Questioned by Mr. Greene.

In looking over the list of material used on some of these works, it seemed to me that they were very much less than the complete equipment for those jobs would have been. It is my belief, after having gone over it, and after having talked with Mr. Lawrence, and seeing his records, that the work must have been furnished with a great deal of material from elsewhere that did not get into his schedules.

Questioned by Master.

Tunnel No. 2, at Sunol, was a new tunnel driven to replace a portion of the old aqueduct, which was abandoned on account of the readjustment of the Western Pacific.

Where I stated that the Merced Tunnel is not brought into this schedule, I mean that I did not estimate it by the same rule I followed for the other tunnels. It was driven through sand, much of it below the ground water level, and that is not comparable to the 6728
other work. It is different kind of work, done in a different way, and would be estimated in a different way. It was a very difficult piece of work; it is the kind of work that under good management, and favorable conditions, may be done rapidly and economically, but on the other hand, there is a great liability of slipping in moving the sand, and stopping the work, causing very great added expense and loss of life.

The list on the first page of my exhibit includes all the tunnels in the system.

I estimated the Seventh Avenue Tunnel as open cut, because it is an open cut job, and I estimated it at less than if it were a tunnel.

The Honda Tunnel, also, is a little different, in that a considerable part of it was driven through sand, but that was dry sand, and not wet sand. I estimated it at the same price as the other tunnels of its size. That is what I should ordinarily do, because in my judgment, driving through dry sand in that way, while it is not directly comparable, would probably cost, as nearly as I could know, about as much as driving it through rock. Mr. Lippincott has estimated it as a sand tunnel. In view of the chance to observe the sand in the Twin Peaks Tunnel, which is now being driven—and which I did not 6729
have when I estimated this, and which seems to be somewhat more favorable than I assumed—Mr. Lippincott has made a lower estimate on that, but even so, I think his estimate ought to be raised, because he has figured all sand, while, as a matter of fact, part of the tunnel was driven through rock.

A joint exhibit entitled "Joint exhibit of gross reproduction "cost of buildings outside of city, with exceptions noted, and exclud-

"ing overhead and interest during construction, segregated into different groups", was offered, with the explanation that the exhibit represents the values which it is agreed may be attributed to buildings which are referred to in the exhibit. It is the understanding of Counsel for both Plaintiff and Defendants that the values which are given in the respective columns, both on page 6 and 6-a for the general groups, and on the preceding pages for the segregated structures, shall be those which may be found as of December 31, 1913. The exhibit was marked "Plaintiff's and Defendants' Exhibit 140".

6730-6732 (Here ensued discussion among counsel on the subject of Mr. Searls' objection to Mr. Lippincott's use of the Census Report for certain computations that he made. Counsel for Plaintiff referred to the case of People vs. Williams, which is reported in 64 Cal. 91, in case the subject does become one for a ruling. The Master advised that he would review the record and see if there was anything for him to rule on.)

The Master called attention, in connection with the stipulated schedules, to Exhibit 136, page 338, which has to do with trestles, where only two figures were agreed on, and stated that he understood that the figures of riveted wrought iron pipe, and of cast-iron
6733 pipe were not included. It was hereupon stated by both Mr. Searls and Mr. Metcalf that the cast-iron pipe was covered by the stipulation, but the wrought iron pipe was not. In view of the Master's remarks, Mr. Metcalf advised that he would go over that with Mr. Sharon.

6734 The Master: These figures that are contained in the stipulated schedules, I understand, are reproduction cost figures, and involve no element of present value. That is, the depreciation is not figured off?

Mr. Metcalf: That is the sense in which we used the words "gross reproduction cost" rather than "net reproduction cost".

Witness: J. H. Dockweiler for Defendants.

Dockweiler

DIRECT EXAMINATION BY MR. SEARLS.

I drove three tunnels in the City of Los Angeles in the outfall sewer; one of them was 5,800 feet; the other two were comparatively short tunnels, and I do not recollect their length. They were of a size to carry a conduit, which, in its finished sections was 6 feet high in the clear, and 4 ft. 6 in. wide at its widest section. It was an egg-shaped section, with the large part of the egg down. Those were driven in 1893. I drove some tunnels in Fresno County in the foothills, probably 300 or 400 feet in length, about the year 1900. Those
6735 were mine tunnels. I am having a tunnel driven now for me in Monterey County in the Los Burros mining district. This is a mine tunnel, and will be 2,000 feet long when finished; it is being driven

through slate formation. It will be high enough inside so that you will have 6 feet in the clear between the timbers and walking on the track; it will be wide enough to permit of a mine car being run through it, and also to permit drainage. Its section in solid rock is about a yard to the foot. In the section requiring timbering, the excavation is about 1½ yard. It is being driven under contract at $6.50 a foot.

I had a drift run from a shaft in Tonopah. I think we ran about 300 feet, and the shaft was down about 500 feet below the surface before we started to cross-cut. The formation is called later anthracite, and is a very hard rock. I have not the record of the cost of that work, although I knew it at the time. I know the cost of a great deal of tunnel work, but that is the record of work that I have been responsible for. I know the cost of other tunnel work from general experience. You go into a mine and ask a mining man what it is costing him to do the work.

I have made a study of the original cost of the Spring Valley 6736
tunnels, I have reports and data from the company's records showing the cost of the work, the number of men employed, and the time consumed. The table which you are showing me correctly shows my appraisal of the Spring Valley tunnels on the cost of driving them in 1913, using wages and material cost for the period from 1907 to 1913.

Pilarcitos No. 2 is 3,426 feet long. It was timbered its entire length. It is excavated to an average section 5½ feet wide by 6½ feet high. It required 40 feet of timber per lineal foot. The material it was driven through is a combination sandstone; I think it is called the Franciscan Sandstone, and it is a comparatively easy
material to handle if you don't overshoot it. The engineer in charge 6737
of the driving would not need to know anything if he had a competent bunch of contractors to drive it, and tunnel men who knew their job. If tunnel men know their job, the engineer does not help them out much; if they do not know it, you cannot teach them tunneling, it is too expensive. As this Pilarcitos No. 2 Tunnel had to be timbered all the way, the rock would be comparatively easy to handle. I have estimated that the following crew will make 5 feet per day in one heading in two shifts of 9 hours each; 3 miners, 2 muckers, a foreman, 2 timbermen and a blacksmith. I figure with that crew there would be 6147 men-days on that job.

Questioned by Mr. McCutchen.

That crew will make 5 feet per day, 2 shifts; they will make 2½ feet a shift.

DIRECT EXAMINATION BY MR. SEARLS.

I give the miners $3 a day, the muckers $2.50 a day, the foreman
$4 a day, the timber men $3 a day, and the blacksmith $3.50 a day, 6738
in a day of 9 hours.

I have a report from Mr. Schussler to the directors of the Spring Valley Water Co., which was made after the tunnel was driven, on the cost of this work. This report is dated December 1, 1867. This copy of the report was made under my direction November 29, 1905, from the reports furnished by the secretary of the Spring Valley Water Co. The copying was done by Mr. H. G. Leonard, 727½ Minna Street, San Francisco, California, and compared with him by myself.
6739 Reading from the report:

Tunnel No. 2: Its length is 3420 feet. It is dressed with an 8-inch brick arch, or egg shape, 4 ft. 10 in. high, and 3 ft. 6 in. wide in the clear, and has 6 feet fall in its entire length, or at the rate of 9 ft. 4 in. per mile. When running full to the top it discharges 55½ cu. ft., or 416 gallons per second, making 36 million gallons per diem. The drifting of this tunnel took 4928 laborers days work, and 132,000 feet B.M. of Redwood lumber. The construction of the brick arch took 670,800 brick, 1120 barrels of cement, 530 barrels of lime, and 2257 barrels of sand.

The cost of the tunnel was as follows:

Drifting	$38,588.93
Open cuts	365.50
Materials for bricking, etc	22,982.73
Labor of bricking	11,499.75
Total cost	$73,436.91

or at the rate per lineal foot of $21.47 total.

Mr. Hazen: I have $21.50.

Mr. Dockweiler: At 10 hours per day it took 49,280 hours labor in driving that tunnel. My estimate on driving it is 55,323 hours, which exceeds the actual time employed by 6043 hours. On the basis
6740 of that number of labor days, and the wage scale and the crew which I have indicated, I figure out a cost per lineal foot for driving of $9.25. That is the reproduction cost.

Questioned by Mr. Greene.

This report is dated December 1, 1867. I do not know exactly in what year the tunnel was built, but it was not built in 1871. The bricking of the Pilarcitos Tunnel No. 1 was about 1871. The facts are that the first Pilarcitos line utilized Pilarcitos Tunnel No. 1, and then swung down along San Mateo Creek, around Cape Horn, and up San Andres Valley. Afterwards this tunnel, known as Pilarcitos No. 2 was driven through the arch in the position it now occupies, and thus cut off that long part of the flume which circles Cape Horn, or Sawyer's Point.

Questioned by Mr. Lippincott.

The figure $9.25 per foot yard is my estimate of the cost of re-
6741 producing it today. That includes everything, timbering, and everything about it, but does not include the lining.

DIRECT EXAMINATION BY MR. SEARLS.

I have all the figures that the books of the company showed on that job. Mr. Schussler's statement in his report is $38,588.93 drifting. The Journal checks that by giving total measurements, untimbered, 82—2½ at $10, $822.08; half timbered, 80 feet at $10.75, $860; timbering 3209 feet, 3½ inches, at $11.50, $36,906.85; total $38,588.93, which agrees exactly with the figures given by Mr. Schussler for drifting. The drifting was done by contract, by R. P. De Noom. It 6742
gives the monthly payments, beginning with October 6, 1865; the last estimate was made February 4, 1867.

Questioned by Mr. McCutchen.

These records do not show what the company furnished to the contractor to perform the work, and I do not know from the records whether the company furnished anything. All I have are the report of the engineer, the copy of the Ledger, and the Journal entries.

DIRECT EXAMINATION BY MR. SEARLS.

Taking the Stone Dam Tunnel No. 1, which is 3,202 feet long, the estimate for that is $9.50 a cubic yard, and that figures out at 6743
the rate of $9.45 per lineal foot. This tunnel is driven as a 5½ by 6½ foot tunnel, and is timbered throughout. Assumed to be driven from 2 faces, with two 9-hour shifts working at each face. This tunnel was finished in 15½ months. That is taken from the records of the company, and the payments made. 2515 feet of the tunnel were driven in the first 10 months. The contract was let to Murphy 6744
& Bugbee. They received $8.25 per lineal foot for driving it, and began their work in July, because their first estimate received was August 1, 1870, which was 250 feet progress. I used the same crew and the same wage schedule with this one as I did with Pilarcitos No. 2. It is timbered entirely, and takes 40 feet of timber for the foot. That checks almost exactly in the case of the Pilarcitos No. 2 with the amount of timber Mr. Schussler says was used—on the same size tunnel. Mr. Schussler gives 132,000 feet of redwood. In this instance it is 40 feet B.M. per lineal foot.

The records of the Spring Valley Water Co. show that the tunnel was driven entirely through before the bricking was done, or the lining. That is so in the case of Pilarcitos No. 1, and of Stone Dam No. 1, and is also the case of Bald Creek Tunnel which leads out of the San Andres Reservoir. As to the other tunnels, the records do not show, as far as I have been able to see them.

The records show whether the tunnels were ever used before they were lined; Pilarcitos No. 1 was in use a long time before it was 6745
lined. It was first driven, and did not meet by 6 feet; it largely overbroke through the inexperience of the men handling the powder, and before the company could use it, owing to the errors in the

grade, it had to build a flume through the tunnel, and at the inlet end of it the flume was pretty near to the top; in other words, owing to the tunnel being driven off grade the water would not pass through, and so they had to build a flume in the tunnel itself, and it was used in that way for several years. The tunnel as originally driven did not require much timbering.

Stone Dam No. 2 is a 7 by 7 tunnel, and slightly larger than Pilarcitos No. 1. To make a progress of 5 feet per heading for 2 shifts per day, I have increased the force which I used on the other tunnels by one mucker and one timber man. I added here for extra timber for the larger tunnel, and other items, so that I brought it up to the price given. My price is $6.50 per cubic yard, but that figured out, gives the driving cost at $10.83 per lineal foot. In all these Peninsula tunnels I do not provide for full timbering; I only provide for quarter timbering in Pilarcitos No. 1, because that was rocky.

6746 Referring to Spring Valley Waterworks Journal, San Francisco, December, 1860, page 11, tunnel Pilarcitos to sundries—and then following the accounts on the estimated cost of the work to the 31st inst. This record shows lumber supplied to this account $80. They
6747 drove 600 feet of tunnel with $80 worth of lumber. You find a total charge of $80 for the timber supplied to this portion of the tunnel. This won't bear it out that this was one-quarter timbered. I am liberal in assuming it to be a quarter timbered.

Questioned by Mr. McCutchen.

I assume it to be one-quarter timbered. It was standing open there for a long while, and doubtless they did put some timber in, but if you are going to line it as soon as you have driven it, it would not be necessary to put in more than one-quarter of the timbering. That is the estimate that I have made.

6748 (Counsel for Plaintiff, in order to keep the record straight, would like to have it appear that with Mr. Searl's consent Exhibit 123 has been permitted to be withdrawn, and that another can be substituted later on).

6748-6749 (Counsel for Plaintiff read an act approved on the 10th of March, 1909, which makes it a misdemeanor on the part of every person concerned with work who works a man underground more than 8 hours a day, and as Mr. Dockweiler had figured on a basis of a 9 hour day in tunnels, Counsel for Defendants' asked and received permission for the witness to correct his figures).

DIRECT EXAMINATION BY MR. SEARLS.

I had these figures taken from the Spring Valley Journal at the
6750 time I made my estimate, but my estimate is above that. This estimate is independent of any of this data as contained in the Journal of the company, but I cite this as data tending to substantiate the fact that my assumption of one-quarter of the tunnels being tim-

bered is a most liberal one. The cost of timbering even one-fourth of the tunnel would not be anywhere near represented by $80, but the Journal, at the bottom of the entry states, "estimated cost 600 "feet tunnel, or say $6.31 per foot". This account is $80. Tools 6751
furnished from this account, 2 cars, freight on the same, $350; powder fuse account, $100; tools for workmen, $370; iron for rails, etc., steel and etc., $250; a sub-total of $1070. Then labor, Pilarcitos section, wages transferred from this account, superintendent 2 months, $80, $160. Blacksmith, 2 months, $75, $150. Carpenter, 2 months, $75, $150. Cook and baker, 2 months, $65, $130. Major-domo, 2 months, $35, $70. 12 laborers, 2 months, $40, $960. Sub-total, $1620. Provisions, Pilarcitos section, say supply taken from this account, board, 17 men, estimated at $1 per day, $1,020. Sub-total, $1020. Estimated cost 600 feet tunnel, or say $6.31 per foot, $3,790.

There is an entry in the Spring Valley Journal which shows that up to June 8, 1861, $10,044.47 had been charged to Pilarcitos Tunnel No. 1. The tunnel was driven through by that time, and the water was running into it. Dividing this $10,044.47 by 1,494 lineal feet gives you $6.37 as the cost of that tunnel per lineal foot. My estimate on that is $8.53 per lineal foot of driving the tunnel timbered. That charge includes everything that they charged up to it, and that is every mistake they made on the work. 6752

Questioned by Mr. McCutchen.

I know that is everything they charged up to it, because they did not overlook or fail to charge anything in the early days. I went through those books to some extent, because I had one month on them. I was accorded the privilege of looking those books over sometime in November or December, 1905.

DIRECT EXAMINATION BY MR. SEARLS.

I have taken these Sunol tunnels at $15 a linear foot straight through. I started out with an equipment that cost me $13,000. It has a compressor installed, say $1,500; a blower, $150; a transformer and motor generator, $1,750; motor, $600; 4400 feet of track, 16 lb. rails, $840; air pipes, say 7,000 feet of 3-inch casing, $1,500; blower pipe, 3,650 feet, at $1,500; drills, say six of them, at $200 each, $1,200; spikes, bolts, etc., $500; cars, 8 of them, at $80, $640. Then I have shoved in extras, housing and foundation, say $920; allowed for getting on job and incidentals $1,000; then I allow for 4400 feet of extra track $1,000. That is $13,000. I charge off this equipment at 50 cents a linear foot, and for maintenance and tools 50 cents, so that I charge $14,564 off to the equipment and its maintenance. My details are made up, labor, $9.20 a linear foot; superintendence, 25 cents a linear foot; timber, $1.32 a linear foot; candles, 12 cents a linear foot; electric power 50 cents; explosives 40 cents; equipment

6753 50 cents, and maintenance 50 cents; adding $2.36 to that gives $15.15, and I round it off and call it $15 a linear foot.

I figured 80 feet of timbering to the linear foot with respect to those tunnels, and that gives a very close check. That is my average of timbering; some may not have been timbered as heavily as others, but that is the average timbering that I use; roughly that is 1,160,000 feet of timbering. I have a memorandum which shows from Lawrence's account there were 1,081,000 board feet used in drifting, so that is a very close check.

Referring to the Lake Merced drainage tunnel, the progress made in the driving of it is shown on Progress Profile No. 93-A of the Spring Valley Water Co.'s records. I don't know the date when the record was compiled, but I was furnished with a copy of it. This
6754 gives the progress made up to certain dates.

Questioned by Mr. McCutchen.

I don't know who made the Progress Profile, but it was furnished to me by the company.

DIRECT EXAMINATION BY MR. SEARLS.

Lake Merced: Summary of direct tunnel charges, excavation, $5.35 a lineal foot; explosives, 68 cents. Timbering, $1.57; drainage, ventilation and light, $1.68, to which I add $2.32, giving me $11.60, and I add 52 cents for wells, and add 16 cents to provide for a bulkhead at the ocean portal, giving me $12.28 a foot.

There are cast-iron pipes laid in the bottom of the Lake Merced tunnel, and those pipes are laid so as to drain back toward the lake. I included driving shafts for drainage purposes, and estimated that
6755 the work, the way it was done, was the proper way to have done it. I learned of the manner in which the work had been done from different employees of the company, and the contractor, at various times, and I used that information as a basis for making my estimate as to the manner in which the Lake Merced Tunnel should be driven, and I used that information in determining the number of these tunnels, and a lot of that material that is in the inventory; you can't go out and measure these drifts at the present time, as they are not there, so I had to rely entirely on hearsay evidence in putting in the units in the inventory.

I assumed 40 feet of timbering in this tunnel per lineal foot, but that does not necessarily mean that the entire tunnel would be
6756 timbered; I just took that. The first parts of the tunnel were driven at a very rapid rate, and did not require very much timbering, but I have made an average allowance of 40 feet B. M. per linear foot for the entire tunnel.

Questioned by Mr. McCutchen.

That would not lag the whole tunnel; that is an average. I assumed it is 2 x 6 lagging, and you would not lag it very tight in

that moist stuff, because the very rate of progress that they made on the progress profile shows that they did not have any trouble, and it stood up fairly well. That I got both by information from the contractors, and from the profile.

Referring to the Lake Honda supply mains, my total unit for that is $5.85 a lineal foot for driving that. 6757

The Master: I take it that is the same as the Lake Honda Tunnel. Your total unit was $11.62.

Mr. Searls: Yes.

Mr. Dockweiler: The material through which this was run was a kind of sandy material, as I knew from the fact that the City of San Francisco has paralleled that tunnel with a drift, and an examination of the material there—I have been out at the Twin Peaks work, and have seen that prosecuted, and noticed the deep cuts and drifts in that vicinity.

Questioned by Mr. McCutchen.

This parallel work parallels this tunnel within about 20 feet; the Lake Honda Tunnel overlies the Twin Peaks Tunnel and so as to protect that work the contractor drove a tunnel 230 feet long, in which——

(The witness stated, upon interrogation of Counsel for Plaintiff, that he was reading from memoranda notes that he got from the 6757-6758
inspector on the job. The Master advised that he could not bring in hearsay evidence like that for original facts; that the man himself could be brought on the stand).

Mr. Dockweiler: The material is sand, with a little mixture of clay in places, and then in other parts of that tunnel it was quite loose, running quicksand. I know that fact from Mr. Schussler's report of December 1, 1867, in which, referring to this as Tunnel No. 3, he states:

"Tunnel No. 3 is the terminus of the new aqueduct, and con-"nects the outlet of the ocean house sewer with Laguna Honda. "The drift was started at the beginning of December, 1866, and "finished September, 1867. The work required 2,240 days work of "laborers, and 55,000 feet B. M. of Oregon lumber. The cost of the "drifting was as follows: Length of drift, 2,787 feet 7 inches, at "$8, $22,300.66. Open cuts, 217.88 cu. yds. at 50 cents, $108.94. "Total cost $22,409.60. As the drift shows quicksand for a great 6759
"part of its length, it was concluded to put the 8-inch brick arch "inside of the timbers, which allows the size of the arch in the clear "to be about 2 ft. 9 in. wide by 4 ft. high."

Questioned by Master.

According to that statement, a greater part of its length was quicksand.

Questioned by Mr. McCutchen.

It did not stand up without timber. I am using timber, and

making an allowance of $1.15 a foot. I am stating this much, that taking the 200 feet that the city drifted, it timbered to some extent, but the material was what you would call standing up material, not loose, that you would have to close your breast with closely braced timber, and leave no spaces on the side at all. The boards have intervals between them, but in my estimate here I have allowed $1.15
6760 a foot for timbering. I have assumed every foot of it to be timbered. I lagged it all. I tight-lagged over the roof. I used 33 feet of timber to the foot. I used a sill 4 x 6 x 2. That is 33 feet B. M.; then I used lagging 6 x 2; then I used poling boards 4 x 2, and then I used 6 x 6 for my posts.

Questioned by Master.

A poling board is a board you run in on the roof, and it is shoved in ahead, and you gradually work it in from a false set.

Questioned by Mr. McCutchen.

They are not inch boards. Poling boards are 2 x 12. The thinnest lumber I use is 2-inch lumber.

DIRECT EXAMINATION BY MR. SEARLS.

Comparing my estimate with the record as given by Mr. Schussler, as to the time taken, 2,240 days at 10 hours is 22,400 hours. Dividing that on a basis of 8 hours a day gives me 2,800 days of 8 hours; 2,800 days of 8 hours at $3 a day is $8,400. 55,000 feet of lumber at $16 is $9,200. Dividing the $9,200 by 2,787 lineal feet, gives you $3.30 cost at present prices. Add 25% to that, and it gives you 83 cents. Then allow 20 cents for powder, 28 cents for ventilation, 12 cents for pipes, 20 cents for track, 7 cents for candles, and 20 cents for smithy supplies, brings it to $5.20 a lineal foot, as
6761 against my estimate of $5.85.

My basis for lining, so much concrete, and so much brick, were the actual conditions as disclosed by an inspection, and the inventory.

Questioned by Master.

I do not agree that the lining with brick would be more expensive than with concrete in the cases where I have used brick according to the inventory, and where Mr. Lippincott and Mr. Hazen have used concrete. I have not made any comparison.

6762 DIRECT EXAMINATION BY MR. SEARLS.

On page B of this exhibit it gives the cost of materials unloaded per barrels for cement, sand, lime and brick at various points, and those figures set forth there are the figures I have used in computing this tunnel lining. Page C gives the cost of hauling per barrel at various points, ranging from 1 mile to 10 miles for cement, sand, lime and brick. Page C gives the cost of mortar for 1,000 brick at various points. Page E gives the cost of hauling mortar required per thousand brick. Page E is obtained by taking a resultant of

these preceding pages, based upon the cost of hauling the proportion of various materials entering into the mortar. Page C gives the cost of hauling a unit. Page E sets forth how many units; it shows, for instance, 2.2 barrels of cement are required for the mortar used in a thousand brick. Page C gives the haul of a single barrel of a single unit, and by taking the unit and multiplying them by the units, page E is derived. I have not the sheet on this exhibit which shows where the cost of the concrete comes in. This is merely arranged for the mortar per thousand brick, and the items that go into making up a yard of brick work. The base prices for cement and sand are the same as I used for the concrete lining. On page 2, where I have the cost of cement per cubic yard, that is the cost at the place of the cement required per cubic yard of concrete, and the 6763
fifth column shows the cost of sand per cubic yard of concrete.

Questioned by Mr. McCutchen.

This memorandum does not set forth the price per barrel of cement. On page B the prices of cement unloaded at these various points are stated, and that is f. o. b. cars in place, but does not include the labor.

DIRECT EXAMINATION BY MR. SEARLS.

For instance on the second sheet, Stone Dam Aqueduct Tunnel No. 2, there is 3,138 cu. yds. of concrete in it. The cement cost $2.65 per yard of concrete; the sand cost 92 cents, the rock or gravel, $1.68, the labor on it $2.78; the forms 4 cents, the incidentals 56 cents; 25% is 70, giving you a total of $9.31 per cu. yd., and the figure used in the appraisal is $9.50 per cubic yard. That gives $8.45 a lineal foot of tunnel, the tunnel being 3,530 feet long. The mix that I used on that concrete was the mix that I got from the company, and the notes from which this table was prepared shows that there were 1.24 barrels of cement per yard, .34 of a barrel of sand, and 1.2 cu. yds. of rock.

Page C indicates the materials delivered on the grounds at the 6764
various prices that I have given. That is the cost of hauling it to the various distances given. It was originally figured on a ton-mile basis, and those are the deduced costs.

The Master: The volume entitled "Tunnels, J. H. Dockweiler" will be marked "Defendants' Exhibit 141"; the volume entitled "Brick work, exclusive of tunnel lining, J. H. Dockweiler", will be marked "Defendants' Exhibit 142".

Mr. Dockweiler: Page C of Exhibit 142; in the case of cement, 1 mile haul, 15 cents a barrel, at the rate of 75 cents a ton-mile; 2 miles 18 cents at the rate of 45 cents a ton-mile; 3 miles, 21 cents, at the rate of 35 cents a ton-mile; 4 miles, 24 cents, at the rate of 30 cents a ton-mile; 5 miles, 28 cents, at the rate of 28 cents a ton-mile; 6 miles, 31 cents, at the rate of 25.8 cents a ton-mile; 7 miles, 34

cents, at the rate of 25 cents a ton-mile; 8 miles, 38 cents, at the rate of 23.7 cents a ton-mile; 9 miles, 41 cents, at the rate of 22.8 cents a ton-mile; 10 miles, 44 cents, at the rate of 22 cents a ton-
6765 mile. The others have been worked out along the same lines.

Questioned by Mr. McCutchen.

These hauling costs include loading and unloading from the team. I arrived at my labor cost, $2.80 a yard; crew in tunnel, 2 men shoveling, 1 man spading; foreman, carpenter and helper; transportation, 2 men; mixing, 1 man, and mixing, 3 men; a mixing crew of 4; that amounts to $2.80 per cubic yard.

6766 Mr. Dockweiler: This structure I am now on is on the Stone Dam Aqueduct; that is a 5-mile haul from Millbrae, and the rock a 4-mile haul from Crystal Springs Quarry. The sand was bought at Niles, and hauled down to Millbrae on the cars, and from Millbrae transported to the site. The price of the sand at Niles I have given under the concrete at Crystal Springs Dam, and that is the same figure that Mr. Ford gave me, but I have worked it out for the different places. All of my rock for concrete for works westerly of Crystal Springs I got from the Crystal Springs Quarry, unless I
6767 may have gotten some at the Davis Tunnel Quarry. I do not just recall now, but I have considered that quarry, and wherever I have used it, I have so stated.

DIRECT EXAMINATION BY MR. SEARLS.

The sand at Millbrae I figured at $1.02 a cu. yd., based on my price of 85 cents at Niles per yard. The figure I have used at Millbrae is $1.02 a cubic yard. I used the figure of 2700 lbs. of sand to a cubic yard.

Page 2, Exhibit 141, Davis Tunnel, $9 a cubic yard; sand and cement are hauled 4 miles from Millbrae; the rock ½ mile from the Davis Quarry. Sand and cement cost, landed at the Davis Quarry, per cu. yd. of concrete, $3.45, and the rock $1.44; that gives
6768 a total of $4.89 for the material. I can't recall at what other tunnels I have used this rock from the Davis Tunnel Quarry. Whenever the Davis Tunnel Quarry was economical, I used it.

The allowance of 4 cents for forms was for the inside forms for pouring concrete. The incidentals of 56 cents are plant charge. The Davis Tunnel, and Pilarcitos No. 1 are all driven by hand. On a small tunnel like the Davis Tunnel you would not need much equipment. A small blacksmith outfit; car and rails. I would drive it all from the San Andres end; there is some steep grade, and it would drain itself. You would use a small ventilator, a small fan, with a small gasoline engine to run it, a small pipe for your ventilation, in addition to your rails and car, picks and shovels, and steel. That is your concrete equipment, and would be in addition to the
6769 equipment for driving it. This covers your tools for mixing.

As to the cost of equipment for driving it, this is an exhaust fan hand work; 250 cu. ft. a minute will cost you $50 with a 5-horse gasoline engine costing you $250; allowing interest and depreciation, that would cost you 46 cents a day, or 23 cents a shift, working 2 shifts. You would use a 6-inch diameter pipe; that is worth about 21 cents a lineal foot; you would use it on two jobs, making it 11 cents a lineal foot. You would have to assume your equipment now and then, and write off a proportionate part. Take 20 cents a foot, that is your first price, and then write off half of that; then your cars would cost you on a basis of 50% salvage, 20 cents a lineal foot. You will have 16-pound rails. That would be $240 for your car and track. A little car is worth about $60. Your rail and your track would cost you roughly $40 per 100 feet. Deduct 50% of that for salvage, or $20. 6770

Questioned by Mr. McCutchen.

The cost of that rail new is 2½ cents a pound, or $50 a ton.

DIRECT EXAMINATION BY MR. SEARLS.

You make an allowance for small tools of about 2% of your payroll. $50 would cover your tools for 1,205 feet of the Davis Tunnel.

Questioned by Mr. McCutchen.

You do not use any drills, it is all hand driving. All you use in that hand work is a couple of single jack hammers, and some drill steel; probably the light weight ⅞ inch steel; then you use a cleaning spoon, and a few pick points that your blacksmith sharpens. You will need shovels, but you can buy an awful pile of shovels for $50.

DIRECT EXAMINATION BY MR. SEARLS.

The powder is included in ammunition. I used 41 cents of ammunition. In the Pilarcitos No. 2 I figured two holes per shift, and I used for one heading daily 8 sticks of ¼ lb. each; I used 4 caps and 4 fuses. That is 41 cents per shift. That will make you 4 feet, which is about 10 cents. 6771

The way I get it is this: Take a 5-foot section. Timber 40 cents at 2 cents a foot, that is 80 cents. Multiply by 5 feet, and that gives you $4. Ventilation for 5 feet is $1.42. Ventilation pipe is 60 cents. Track and cars $1; candles 30 cents; blacksmith supplies say 50 cents, and that with your powder makes $8.23. That is your material. Your labor is $27.50; adding that gives you $35.73, and 25% on to that is $8.93, and divided by 5 that gives you $8.92 a lineal foot.

I write off $670 total cost of the equipment for this tunnel. It will cost a little more than that. I got that $842 by adding in $300 for ventilating equipment, $132 for pipe, $240 for cars and track,

$50 for tools, and $120 for powder and shooting. I would say $1,500 would cover the equipment charge for that tunnel, but to play safe, call it $2,000.

The total cost of this tunnel was $24,357.50, of which $2,000 represents the total equipment for driving and lining, leaving $22,-357 as the cost, exclusive of equipment, and that also includes my 25%, which is added to the labor. If your computation is correct, $844 would have to come off of that, leaving $21,513 as what Mr.
6772 Lippincott might call the direct cost of that tunnel.

If your computation and your assumptions are correct, and you were to reduce my figures to a basis of direct cost and indirect cost, the percentage of my direct cost, which should be applied as indirect cost, is about 13%.

Questioned by Mr. McCutchen.

The 25% covers profit and incidentals. I would not attempt to tell how much is profit and how much is incidentals.

6773 The old Cruickshank Mine is the one I refer to in the Los Burros District, and you reach it by taking the Southern Pacific train to King City, and then going by auto to Jolon, and then from there you can drive by auto to the Newhall Ranch at the Nacimiento River, and from there a 10-mile trail will lead you into the mine.

We generally go in with the material around Pt. Gurda and lighter them across, but some of the material we did take in on the burro trail. That $6.50 covers the labor of driving, and I furnished to the contractor the track and the car, and I let him have the tools that were there, and the timber we furnish, and he puts it in. He furnishes the powder and caps. The timber, I think, we paid the Government $7.50 a thousand stumpage on. I have forgotten what it cost us to get that timber out, but it is a fine class of redwood. I assume that it would cost $20 a thousand. My estimate for driving that tunnel is $8 a foot to the company after furnishing everything,
6774 but the contract labor is $6.50.

He has to bring his powder on burros from the Nacimiento River, and Jolon I think is the nearest store where he can buy his materials. I had a ton of powder sent in, and sold it to him at the price we paid for it, landing it there. He drives it by hand power. The material is a pretty tough rock; I would not know exactly what to call it, but the formation there is slate. We are quartering—about three-quarters; I would like to run the other way, but am aiming to hit the ledge at a point which will be two feet in from the portal. My judgment, from the formation, would be that we would hit on a quarter. The tunnel, I guess, is in a little over 400 feet now. I don't know just how many men he has on the work, as I have not seen the work since he started. He is a miner who lives in that neighborhood, and puts in all the time.

DIRECT EXAMINATION BY MR. SEARLS.

My base price of brick unloaded at each of these stations which I have mentioned on page B, Exhibit 142, is $7. The ton mileage cost for the hauling of the brick is given on page C of Exhibit 142. 6775

1 mile	$1.44	per thousand	48 cents a ton mile
2 miles	1.94	per thousand	32.3 cents a ton mile
3 miles	2.43	per thousand	27 cents a ton mile
4 miles	2.93	per thousand	24.4 cents a ton mile
5 miles	3.43	per thousand	22.9 cents a ton mile
6 miles	3.93	per thousand	21.8 cents a ton mile
7 miles	4.43	per thousand	21.1 cents a ton mile
8 miles	4.93	per thousand	20.5 cents a ton mile
9 miles	5.43	per thousand	20.1 cents a ton mile
10 miles	5.93	per thousand	19.8 cents a ton mile

I assume a percentage of lime, because lime makes the mortar work easily. Mr. Schussler's report shows that lime was used, but I am not sure of the percentage. I don't know whether I used the same mix he did for the brick mortar or not.

Questioned by Mr. McCutchen.

On page A of Exhibit 142 I give the mix: 1 cu. yd. to 2 cement mortar contains 3.2 barrels of cement, 9/10 of a cubic yard of sand, and seventy-five one-hundredths of a barrel of lime. My base price of lime is shown on page B of Exhibit 142. 6776

Questioned by Master.

In using lime it adds greatly to the imperviousness of the mortar without materially reducing its strength. The final analysis of nearly all cement is 60% when you come to analyze it.

Questioned by Mr. McCutchen.

I don't know that it is impervious if you increase that percentage of lime in the mortar. You can't dose it too heavily.

DIRECT EXAMINATION BY MR. SEARLS.

Pages D and E, Exhibit 142, that the cost of mortar per thousand brick, and then the cost of hauling the material, based on the quantity that goes into the mortar. Page F shows the total cost of the mortar with the materials and hauling charges added in per thousand brick at various points. The following three sheets, marked 7, 8 and 9, give similar statistics for mortar inside the City of San Francisco. The former sheets refer to the outside system. Sheet 10 gives the distances from the railroad to the structures in the city distribution system. That is the distance that the material would have to be hauled.

Questioned by Mr. Greene.

I got those distances by scaling on the map the routes the teams would travel.

Lakmere Spur is a spur that runs from the Southern Pacific down into the Merced Ranch. We took those distances by finding
6777 out what routes the men would travel, and then we scaled those routes on the map.

DIRECT EXAMINATION BY MR. SEARLS.

Pilarcitos No. 2, Exhibit 141; I take that at $52.55 a thousand, which I arrived at as follows: I assumed that a bricklayer would lay 500 bricks in 8 hours. I use one bricklayer and one laborer; one bricklayer at $7 for an 8-hour day, and one laborer at $4.50 for an 8-hour day, and I board these two men at $1 a day. It makes the cost of labor $13.50 for 500 brick, or at the rate of $27 per thousand brick. The cost of mortar delivered at this point is $7.09 per thousand brick, and by "mortar delivered" I mean the elements that go to make that mortar. That is a 5½ mile haul. I assumed that water is 22 cents; lights will be 63 cents; templates and scaffolding 18 cents; cost of brick $7 per thousand at Millbrae; and hauling them to the job 5½ miles $3.68. I add 25% for profit on the labor, which is $6.75, and the total is $52.55 per thousand. It figures out $11.01 per lineal foot.

6778 The Bald Hill Tunnel, on the Stone Dam Aqueduct, has 530,000 brick in it. I divided it into two sections for bricking, and allow $33.91 for the brick per thousand in the upper section, and $38.09 in the lower section. The reason for that is it costs more to lay them in the lower place, as a man has to stoop down. The average price is $36. My price of $33.91 for the upper section is derived as follows: I use a crew of one bricklayer and one laborer. The bricklayer gets $7 and the laborer $4.50. I board them at $2, and it costs me $13.50 for these two men. I estimate that a bricklayer will lay 1,000 brick in 8 hours. The cost of laying is $13.50 per thousand; the cost of mortar, including haul, is $6.37 per thousand brick to this place; water is 22 cents; cost of hoist is 70 cents; the cost of the brick at Millbrae $7 a thousand, cost of hauling them to the job, two miles, $1.94 per thousand; cost of lights 63 cents per thousand; 25% profit on the labor gives $3.55; that totals $33.91 as the cost of the upper section, or arch section.

(The Master here called attention to the fact that the exhibit
6779 makes it the lower section, and that the upper section in every case is the more expensive section. The witness then stated that the lower section was the cheaper $33, and the upper he has at $38).

Questioned by Master.

I have templates in my upper section, but that does not follow: In handling the upper section a man has to backfill; as you make your lower section you form your invert—a carpenter will set a template for the first one, and after that the mason sets his template, and he uses material to smooth around. That would increase the

cost by the cost of the template and the labor of placing it, but in the arch he has to backfill material. The template is a form that you throw the arch over; after the brick arch is in, then he has to throw in his earth and backfill between the top of his arch and his tunnel wall. That would make the cost more in the upper section, and that is what my exhibit shows. My notes here show for the lower section $33.91. 6780

Mr. Searls: I think the error arose this way: I didn't see these notes in the ''remarks'' column, and I assumed the first section was No. 1, or the upper section, and asked him about those.

Questioned by Mr. Greene.

Mr. Dockweiler: The upper section is the more expensive. The reasons I first gave for the opposite of that I do not think apply in this particular case. I remember now how those tunnels were lined. I am positive of that now for this reason, that in the Los Angeles Outfall Sewer one bricklayer laid 1,000 brick, and then he quit. That was the sewer I built, and there was an agreement between these bricklayers and the contractor. The forms were ribs of iron. The invert was built of concrete. The arch was brick. The agreement was that as soon as a bricklayer laid 1,000 brick a day he quit. They laid about 1,000 brick in 8 hours, and they did not take the full 8 hours to lay them either.

NINETY-FOURTH HEARING. FEBRUARY 10, 1916.

Witnesses: J. H. Dockweiler for Defendants.
Geo. L. Dillman for Defendants.
J. B. Lippincott for Plaintiff.

Witness: J. H. Dockweiler for Defendants. 6782

DIRECT EXAMINATION BY MR. SEARLS.

I have a copy of a letter to Mr. Jesse H. Steinhart, from the McNear Brick Agency, in which they give the price of brick for the 5 years beginning with the year 1909, and ending with the year 1913, as follows:

For 1909, $6.50 a thousand; for 1910, $6.30 per thousand; for 1911, $6.80 per thousand; for 1912, $7.20 per thousand; and for 1913, $6.73 per thousand. This price is based f.o.b. cars San Francisco, or on any wharf in San Francisco. I took the average of that quotation, and determined $6.71 as the average. I rounded that figure off to $6.75, and called the brick, unloaded, $7 a thousand; I allowed 25 cents for unloading. I did not determine the point to buy the bricks at. They could be obtained at any of the points that are shown in the table.

Questioned by Mr. McCutchen.

Wherever I have given a quotation Millbrae—company's spurs, I have a note here $6.75 a thousand. $7 is the figure I have used unloaded.

DIRECT EXAMINATION BY MR. SEARLS.

From the Remillard Brick Co., under date of May 1, 1914, I have
6783 the following: "Confirming verbal quotation given you today, beg to "quote you price of $6.50 per thousand for No. 1 hard burned brick "f.o.b. cars at Sunol, Niles, and Newark, California."

I have the contract prices paid by the City of San Francisco for what they call common red brick, in 1907. Offhand, I would say that common red brick is not the class of brick that is suitable for the construction of these tunnels. I would want a hard burned brick. I don't know what they mean by the term "common brick". I am using a hard burned, first-class brick. The City of San Francisco's purchase schedule gives for brick, 1909-10, $6.75; 1910-11 I have not got; 1911-12, $6.50; 1912-13, $6.95; 1913-14, $8.10, delivered to the corporation yard. That is equivalent to $6.60.

Questioned by Mr. McCutchen.

These quotations are not for common brick. The brick I have quotations on are sewer brick. That is, I mean, for tunnel brick, not sewer brick. A good brick; what is known here as sewer brick, is a vitrified brick.

That letter that I read further states:

"In regard to your inquiry for price of brick for San Francisco "market for the past 5 years, we beg to state that the McNear Brick "Co. have sold 18 million brick per year, at prices averaging as fol-
6784 "lows." Furthermore, they say: "The price of brick always fluc-"tuates throughout the year in accordance with the demand, and is at "the present moment selling at about $6.50 per thousand average."

The Master: There is nothing in there to show the quality of the brick referred to.

DIRECT EXAMINATION BY MR. SEARLS.

I should say that there is not any difference in the market price of the red brick, such as is used. They are brick burned by kiln. The output of those kilns is a first-class product. There may be what you call a clinker brick, which is used for ornamentation, but the average run of those brick is practically suitable for tunnel work.

Questioned by Master.

I haven't any data that made a distinction between common brick and hard-burned No. 1 brick. The data I have I got from the purchasing agent of the City of San Francisco. I didn't know the significance of that term as they interpret it, as to what it means.

Questioned by Mr. Searls.

This is from Mr. Kast, and he makes the quotation here common red brick.

(Counsel for Defendants advised that he would produce Mr. Kast to show the quality of brick that is purchased.)

Mr. Dockweiler: The quantity of brick that is to be used in this work is such that you would have all of these men giving special figures. I am pretty sure that you could even shade the price that I 6785
have used.

Yesterday I explained my division of the tunnel into the two sections, the upper and the lower; my testimony now is that the upper section costs more to lay than the lower section.

On the Sunol Aqueduct No. 2 there is more concrete to the running foot, and my unit price is $9 per cu. yd. for it. My unit price on Tunnel No. 3, per yard, is $9. The fact that I have a cost of $11.78 for lining on Sunol Aqueduct No. 2, as against lower costs in the other tunnels, means that there is more concrete. This is per running foot. At $9 per cu. yd. there is more concrete in the tunnel per running foot than there is in the other. The only explanation I can give of the difference is that the agreed inventory shows more cu. yds. to the foot than in the case of the other tunnels.

It is my impression that there is 1/3 more concrete in that one
than in the other tunnels. My exhibit shows tunnels 2, 3 and 4 as 6786
being the same size, 6 by 5 ft. 9 ins., but my recollection is that the walls are very thick on this special one. I don' think it is an error in the exhibit.

Mr. Hazen: I did not consider those sections in my concrete schedule; I didn't figure it that way. I don't see any reason why that tunnel should be bigger than the others. The only reason I have been able to have, in my opinion— and that is simply my idea of it, and does not rest on any evidence—is that perhaps they drifted it larger than they needed it, and then enlarged the inside section to reduce the cost of lining.

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Dockweiler: Tunnel No. 5 was all cut and covered; the others were partly. The inventory for No. 2 shows 856 lineal feet, 1,122 cu. yds.; the other tunnels, for instance No. 3, is 1,576 lineal feet, and 1,553 cu. yds. So that is the answer; there is more concrete per lineal foot in this tunnel. I think that was the tunnel that was afterwards
built on the change in alignment by the Western Pacific, and I think 6787
they built it extra heavy.

Mr. Hazen: It was on the change, but the question is, why they should have have built it larger and heavier?

Mr. Dockweiler: Well, those are the dimensions given me by the company as to the thickness of the lining. My computation notes will show that, but they are up at the City Hall.

DIRECT EXAMINATION BY MR. SEARLS.

Referring to Exhibit 141, Sunol Aqueduct Tunnels; Tunnel No. 5 is excavated as an open cut, and Tunnel No. 1 was excavated as a tunnel, with the additional length caused by the two side exit tunnels.

(Counsel for Defendants called attention here to the fact that on the first page of Exhibit 141 that the Sunol Aqueduct Tunnel is put in with the small letter ''x'' after the concrete, which refers to a note at the bottom, and at the bottom it is marked ''excavated as open cut''. Tunnel No. 5 has a small letter ''y'' after it, and is marked with a note ''included in excavation of two side exit tunnels''. It is Counsel's opinion that those two should be reversed, in-as-much as the witness has placed a figure of $1.02 on the one numbered ''y'', and he asked that the exhibit be corrected on its face.)

6788 Mr. Dockweiler: I have not my notes here showing the manner in which I arrived at the Tunnel No. 5. I don't recall whether I used the same units there that I used for excavation generally in soft rock, earth, and hard rock. Referring to cost miscellaneous per foot, in column 9 of my Exhibit 141; I don't see just how this resolution was made. This is determined based on the cost per lineal foot. I don't recall just how that was gotten at. I figured it by the cubic yard; this has been resolved into the lineal foot basis.

Questioned by Master.

I don't recollect how these figures have been combined. I would not want to attempt to answer that, because I don't know what items were used to make that. This is a resolution per lineal foot of the figures, whereas I have computed them by the cubic yard.

Questioned by Mr. Searls.

Referring to the Merced Tunnel; I could not tell whether the $6.18 there covers my cost of handling the water. Mine is made by the cu. yd., and these are resolved by the lineal foot. I will examine this, and let you know just what that does mean.

6789 The Master: That is the one where this table shows a difference of $2,000 between his appraisement and this figure.

Mr. Searls: Yes, your Honor.

The Master: His Exhibit 141 shows $77,304, and this shows $79,461.

Questioned by Mr. Searls.

Mr. Dockweiler: I didn't find out the reasons for that difference.

Exhibit 142: I have used the same unit prices for brick in the brick structures outside of the tunnels as I did in the case of the tunnel lining, and also for sand, cement and mortar.

Where the brick work was being done in the open, such as brick walls, reservoirs and towers, it depends entirely upon the nature of the work at what rate a mason would work laying the brick. Take the gate tower and the stand-pipe in Crystal Springs Dam, which appears on page 13; the crew was 1 working foreman, 5 journeymen, 3 help-

ers, a crew of 9 men; they will handle 2,000 brick a day each. Just below it, for 2 men, only one a journeyman, I am handling only 800 brick a day. On the first I had a foreman, and 5 journeymen, and 3 helpers. That would make 6 journeymen, and they laid 3,000 per day instead of 2,000. 6790

Questioned by Master.

My helpers would be hod-carriers, and that would be 3,000 brick a day of 8 hours.

Witness Geo. L. Dillman recalled for Defendants. Dillman

DIRECT EXAMINATION BY MR. SEARLS. 6791

I have been connected with tunnel work since 1890, usually as engineer in charge of construction, the laying out, planning, specifications, and supervision of contracts. First, my experience was largely with railroad tunnels, but recently I have had some direct connections with small water tunnels. The most pertinent definite information that I have is from the tunnels which were driven under my direction on the Oakdale Irrigation work. They are small tunnels, but most of them were not as small as these Spring Valley tunnels. There is one tunnel 7,000 feet long, which is 11 feet wide, and 7½ feet high, circular arched top of 5½ feet radius. That was driven through soft material, which was a little bit softer than the material on the average of the Spring Valley tunnels. I say that from the examination of the adjacent country rock, and with a thorough knowledge of the clay shales, and the soft sandstone that these Oakdale Tunnels penetrated. The 7,000 foot tunnel ran 2.4 cu. yds. to the foot. It was generally unlined, but timbering was put in for 200 or 300 feet. In one case it was so soft that the lagging had to be driven ahead. That was the only expensive part of the tunnel. The work was very rapid; they built the 7,000 foot tunnel in 3½ months.

Questioned by Mr. McCutchen.

That was working from 6 faces, 2 shafts. The men averaged about 9 feet a shift. All of it was shot; very little drilling was done; 6792
it was soft enough to bore. They used electric hoists in the shaft. They had some ventilation, such as tin air-pipes, and a motor-driven fan. There was very little pumping for drainage. They made 9 feet per shift, or 9 feet at each heading. At times they would go considerably faster than that, but it averaged about 9 feet a shift. This tunnel is now being lined by Edward Malley, a contractor of San Francisco, at cost, plus a percentage, but with a guarantee that the lining will not exceed $12 a cubic yard.

Questioned by Master.

It is being lined with concrete.

Questioned by Mr. Searls.

I don't know what the work was sub-let at. The Utah Construction Co. got \$20 a foot in bonds for that tunnel. I think the prices, so far as that goes, on these north side tunnels, which I will give you later, are more pertinent than this. I don't think anybody can say exactly what bonds are worth. They can specify sales. These particular bonds I have purchased and sold at various times; my purchases have ranged from 68 to 80 cents; they are now quoted at between 85 and 90, but at the same time, even with that knowledge, the absolute value of bonds is a very fluctuating thing. It is like all other values, a matter of opinion. There were a great many of these tunnels, and
6793 one was a little bit of a tunnel only 4 feet wide, and 6 or 6½ feet high; it was on a lateral. I had no plans of it even; I don't think plans were ever made for it. I simply told the tunnel men to go ahead and drive it. It was not included in these contracts. While I can get the cost of it—the cost was in bonds too—it was a cheaper tunnel.

There were 6 tunnels of what I call the north side tunnels at Oakdale, ranging from 500 to 1,485 feet in length. They were 10 feet wide, and 6½ feet high, the top being in circular sections of a 5-foot radius. They ran 2 cu. yds. to the foot, and were let at \$16 per foot in bonds. They were sub-let for \$10 a foot in cash, and were again sub-let at \$6.50 per foot in cash to station men, who averaged \$10 to \$13 per day each. The longest tunnel was driven at the rate of 10 feet a shift. There were no working shafts in these tunnels. In one, and possibly two, they put a small ventilating shaft, which was not included in the cost. They did it at their own expense rather than put in air; no air was put in these north side tunnels at all.

Questioned by Mr. McCutchen.

That was driven entirely by hand power. They used mostly augers. There were some tunnels on this work through very hard rock that cost a great deal more money; they were let, I think, at \$24 a foot. The attempt to work them by hand was entirely futile. Before they finished their contract they had to put in power, which was electric in this case, and included a pole line from the Sierra-San Francisco Co.'s power line, and a compressor plant, and they lost considerable money on those hard rock tunnels.

6794

DIRECT EXAMINATION BY MR. SEARLS.

The dimensions of those tunnels was 13 feet in width, and 6½ feet high, just a semi-circle. That was the dimension intended, but the rock was so hard, and broke in such irregular ways, that while they have a section equal to this, they are not semi-circular at all, they are flat-roofed. The rock was locally known as green stone; it was the hardest tunneling I ever saw.

Questioned by Mr. McCutchen.

The Owl Creek Tunnels were very largely in this hard material;

the other canyon tunnels were hard tunnels too. The Owl Creek Tunnels were especially hard, and it was those two tunnels that required the power plant. They could not be handled by hand at all. This green stone is in veins, and those tunnels were largely in this green stone. When they were not in the green stone, they were in very 6795
hard material, but not as hard as the green stone.

I do not know what the geological maps of the Government show the material to be. They were very interesting tunnels. In this same country that I spoke of the 6 tunnels being driven under my direction, they are now driving another tunnel 7,200 feet long, which has an egg-shaped section. It is 7 feet wide and 8 feet high, net, and that is after being lined and timbered.

Questioned by Master.

All these figures that I have given are the net sections. These tunnels are not lined. This does indicate lining, but as a matter of fact, they were not lined. We found that they would stand, and they have been standing for some time now without lining. A great many small tunnels are not lined.

DIRECT EXAMINATION BY MR. SEARLS.

They are preparing to line the soft tunnels. This contract was let at \$3.49 per cu. yd. for excavation, and \$15 per cu. yd. for concrete lining. The unlined section will contain 1.6 cu. yds. to the foot, which will make that cost \$5.60 per lineal foot for excavation. The lined section will run 2.1 cu. yds. to the foot, making the excavation cost \$7.35. The lining will run half a yard to the lineal foot, which at \$15 would be \$7.50, making the cost of the lined section \$14.85. The contractor furnishes everything, labor and materials, and puts it in 6796
place. These are the most definite recent records that I have.

In December, 1912, in the publications of the American Society, Volume 75, is described a tunnel in Shasta County, California. W. C. Hammatt describes a tunnel which ran 2½ cu. yds. to the foot, 8½ feet high, 9½ feet wide, in which the excavation ran \$3.60 per cu. yd., or \$8.94 per lineal foot, and the timbering \$4.38 per lineal foot. The material is not described very well, but I know that country somewhat, and it is a harder material than the tunnels on the Peninsula, and still harder than the tunnels I have described at Oakdale.

Questioned by Mr. Greene.

I don't think that tunnel is all timbered; where it is timbered it costs that much. My description of the ground is a description of 6797
the general locality, and not of the particular ground, as I never was in that tunnel.

Questioned by Mr. McCutchen.

This tunnel is over in the Bully Hill country in Shasta County—Iron Mountain. I don't know who did the work, but W. C. Hammatt describes it, and he is an engineer.

DIRECT EXAMINATION BY MR. SEARLS.

The Spring Valley tunnels are in what is known as soft material, and that difference between soft and hard material makes more difference in the cost of driving tunnels than any other one thing. While it is true that the cost somewhat increases as the section decreases, it is less true of small tunnels—less pertinent in connection with small tunnels, than it is with large tunnels. The cost of tunnels in the same formation, with not much difference in size, varies directly as the material moved.

The Pilarcitos Tunnel No. 1 is estimated at $4 a cu. yd. for excavation; $25 a thousand for brick; rubble masonry at $10, that is at the portal—$10 a cubic yard; concrete at $8; excavation of earth at 50 cents; and timbering at $45 a thousand. That is an easy tunnel to drive, has small sections, and ought to stand very well.

6798 Expert tunnel men would not have any overbreak on the Peninsula, unless they ran into very faulty material, which is not indicated by anything in the country. I have estimated no overbreak beyond what was included in the excavation. Unnecessary overbreak is always from over shooting in some way.

The amount of rock which will blow out of a given class of material depends pretty much on the angle at which the back holes or top holes are driven, but it is almost a waste of time for an engineer to try and direct the placing of holes in tunnel heading. Every shot that is placed gives some information as to the quality of the material. Good tunnel men who are working in a heading will always put to use the information gotten by the last shot in placing the next shot, but as to just how it is done in every case will depend on the direction of the seams. If you have not good men in tunneling heading,
6799 you are going to have trouble anyway. I am presuming that you have good men in all these headings. There is a gang of laborers on this coast who are very expert tunnel men, with whom I first got acquainted in connection with Western Pacific work. They are not day laborers; they are contractors, or are usually what is termed station men. That is, they will agree to go into a tunnel and do a definite amount of work, and their pay depends upon the amount of work done, and not on the time employed. They are, to all intents and purposes, contractors, but they are not financially able to take the contract. They follow the big contractors, who depend on them for doing this work. In that way they get the work done at a minimum price, although the laborers get a maximum compensation. These tunnel men at Oakdale made, as I said, from $10 to $13 a day.

Pilarcitos No. 1; all these tunnels could be driven more economically without a special plant. Hand work, hand drilling, and shooting with fuses. While there would be some little ventilation in many
6800 cases, in some cases there would not be any ventilation at all; that is, I mean artificial ventilation. A ventilation fan is run from the outlet

of the tunnel, and by switches in the pipes, is made to exhaust or blow in air, as you want. If you had electric power handy, you would run it with a small motor, but if not, you would probably put in a little, cheap gasoline engine.

Questioned by Mr. McCutchen.

I mean, when I say shooting with fuses, that that method would be used instead of electric firing. With most of these I would use low dynamite. In some cases I would not have any artificial ventilation. I would simply wait a little while until after the shot was off, and it would ventilate itself. In the long tunnels I think you should have ventilation.

DIRECT EXAMINATION BY MR. SEARLS.

In moving my material out, I think I would use a car, and let the men handle it; I do not think I would even use a mule.

Bald Hill Tunnel, 2,820 feet; excavation solid rock at $4; excavation sand at $3 per cu. yd.; lining with brick $25 a thousand. That
is not hard material there. That is, there is nothing to evidence hard 6801
material on the surface, and I have considered that fairly easy excavation. It was not quite as soft, and easily handled as some of this Oakdale work, and I have estimated it at a higher price on that account. I think I have used a figure of $25 per thousand for brick lining uniformly. I did not make any analysis of that, but I placed that value on the brick, not because I had ever lined a brick tunnel, or knew definitely the cost of putting a brick lining in a tunnel, but because I believed it was not better than concrete, and should not have been used if it were more expensive than concrete; concrete at $12.50 a cu. yd. would make the equivalent volume of lining of brick $25 a thousand. So far as the brick goes, it is rather a question of value than of an analyzed reproduction cost.

Sunol Tunnel No. 1; 7,502½ feet long. The excavation I computed at $4 a cu. yd.; concrete lining at $10 a cu. yd.; shaft excavation at $4 a cu. yd.; cast-iron covers and steel rods at 5 cents a lb.; the side exit tunnels, used for disposing of excavation and backfill, at $5 per lineal foot.

Mr. Metcalf: We have reduced that to a lineal foot basis in this comparative table. Sunol Aqueduct Tunnel No. 1 is about $18.50.

Mr. Dillman: My reason for placing a price that averages $18.50 6802
on the Sunol Tunnel was that it was just according to the inventory; the prices put on are very much the same per unit, but there are more units, more yards, and more lining. By more yards, I mean more yards to the foot.

Questioned by Mr. McCutchen.

I don't think my charge for excavation is uniform. It was not intended to be. It happens to be $4 in each of those cases. On Tunnel No. 5 at Sunol those units are the same. I did not assume

that that was an open cut, and the one I have in this one, the inventory does not show as an open cut excavation. I used $4, $10, and $5.

Mr. Dillman: I have here the agreed inventory before me. This shows 2 side exit tunnels. They are simply adits run in from the bank to reach the tunnel and make an extra heading so they can work at
6803 more frequent places on the tunnel. They really should cheapen the work. I put them in because they were in the inventory—page 81 of Mr. Dockweiler's inventory—at $5 a foot.

The Master: That does not compare with this. I observe that the agreed inventory does not show Tunnel No. 5 as an open cut excavation. I take it that that has been supplied by the Plaintiff's engineer. There is also an error, apparently, in the inventory which was supplied to Mr. Dillman for his estimate. This item entitled "2 side exit tunnels" in his volume is shown under Tunnel No. 5, though the stipulated inventory shows it under Tunnel No. 4. That would make a little adjustment there in the figures for 4 and 5.

Mr. Dillman: That would make a difference in my figures; it would reduce the figure on Tunnel No. 5, $2,000, and if they belong up above, it would add $2,000 to Tunnel No. 4. If the 400 feet of adits were taken from one and put on the other, it would be a stand-off.

Questioned by Master.

If that was cut and covered, I would not estimate it at $5 a
6804 cubic yard. I used $4, as that would be cheaper work. There would be more yardage, but considerably less cost per yard, and the aggregate would be less.

Mr. Hazen: Of course, the assumption that it is open cut involves a great increase in yardage, as Mr. Dillman says. The figures suitable for open cut would have to be applied to a much larger basis. That is what I did in my estimate.

I can give you my figure now. The average depth of the cut was about 11 feet. I assumed the excavation averaging 8 feet wide; that made 5,820 cu. yds., partly earth and partly rock. It is a deep cut, and more expensive than a shallow cut. I estimated that at $1.25 a yard, amounting to $7,300; for the concrete I estimated it at $10 a yard, $17,620, or a total of $24,920. There was some adjustment after that, but that is the basis of the calculation. The excavation is intended to include the backfill. My total cubic yardage is 5,820.

Mr. Searls: Mr. Dockweiler, in his inventory has 6,099.

The Master: Then those figures are Mr. Dockweiler's figures.

6805 Mr. Hazen: That is a pretty close check with mine.

The Master: He has also used about 2,121 yards of backfill at 20 cents.

Mr. Metcalf: These details were apparently Mr. Dockweiler's figures, because he was the only one who gave unit costs in this comparative sheet which was gotten out.

Mr. Searls: Mr. Dockweiler used 30 cents for excavation, and 20 cents for backfill. He has assumed, I think, 2,121 cu. yds. of backfill at 20 cents, and 6,099 cu. yds. of excavation at 30 cents.

Mr. Hazen: I should think the excavation would cost a great deal more than 30 cents in that location.

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Dillman: The Lake Merced Tunnel I have estimated at $4 a cu. yd. for all excavation, and $30 a thousand for brick; $1.20 per lineal foot for 6-inch pipe in place.

Questioned by Master.

My total estimate is $61,211, without any percentage addition.

DIRECT EXAMINATION BY MR. SEARLS.

The excavation in that tunnel is very soft. I expect the $4 to include the auxiliaries if any timbering were necessary temporarily in taking care of the water. The actual cost of excavation, no doubt, would be a good deal less than this without those considerations.

Questioned by Mr. McCutchen. 6806

If any timbering were necessary to take care of the water, the $4 allowance would do that. If the tunnel is driven from the outlet end, I don't think you would need any special appliances for taking care of the water. From the fact that they had shafts in there, I presume they drove it in a hurry, and worked from these shafts.

Questioned by Mr. Searls.

These drain shafts are included in my inventory just as yardage at $4 a yard.

Questioned by Mr. McCutchen.

I do not take it for granted that all of this work is below the water level. If it is a fact, it has come to my knowledge only within the last few days here in the court room. There is no evidence of its being below the water level now. I presume, though, the tunnel would drain off that ground water. I have not considered that it was under the water level badly at the time the tunnel was run, or that there would be very much water to take care of. If there were a great deal of water, and that sand turned out to be quick, I can see how my price would not do the work, but I had no knowledge, and I have not yet, except from the inference drawn from the testimony here, that there was anything of the kind.

Mr. Searls: I will state here that the information that we have gathered from the Spring Valley records is that there was no such trouble encountered all the way through; also that it took about 500 feet of hard driving. 6807

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Dillman: The brick lining, intake pipe, structure No. 4, Crystal Springs, I have estimated at $25 a thousand. The brick in the registering gate-house at the outlet tunnel I have estimated at $20 a thousand. I don't know why I made that difference. A good mason on outside work should lay from 2,000 to 4,000 brick a day. I would figure probably about 1,000 as an average performance of good work on tunnel work. The cost of brick work in the tunnel is the cost of getting the brick and the mortar in. If the mason can be waited on, he can lay pretty near as much brick inside as he can outside, and I include the arch in that. He lays his arch pretty nearly as fast—not as fast as he would a straight wall, but by no means at a slow rate. The arch is laid to a form; they lay that up
6808 quite rapidly. I have considered he would lay about 1,000 brick.

I did not assume a base price for brick in these computations. I know that brick at the Remillard Brick Yard can be bought for about $6 loaded on the cars. I presume that $7 is not far from a right figure at San Mateo or Millbrae, or wherever the most convenient shipping point is. However, my brick is not estimated with any details of that kind.

In making up the mortar for laying brick, the practice on this coast, and I think it is a very good one, is to include from 15 to 25 percent of lime. That is, 15 to 25 percent of the volume of the cement in lime. The reason is that it works so very much easier; straight cement mortar is a very hard material. It is hard to handle, does not flow nicely, and does not work well under the trowel. The addition of this little bit of lime makes it work so much easier that I think the practice on this coast is to be commended. All brick masons will use that if they are allowed to.

If it were necessary to do some backfilling in tunnels, I would not consider it advisable to use a concrete mixture for such backfilling. I have never seen that used. Generally, backfilling in tunnels is made of loose stuff, or cordwood, or plunder of that kind.

Lippincott Witness J. B. Lippincott recalled for Plaintiff.

6809 CROSS EXAMINATION BY MR. SEARLS.

Referring to Exhibit 133, in which I state, for small tunnels a half a mile or so in length, drilling may be hand, and cars handled by mules with due economy, and that heavy equipment is of small importance: There are a number of tunnels about half a mile in length, and it is a little over half a mile for practically all of them,
6810 but I will call your attention to the statement contained in the memorandum in that exhibit, wherein I say an aggregate of small ones. The equipment would have to be moved from place to place.

On the Sunol tunnels, which are rather close together, you could use a central station and distribute air in driving them.

The statement which I intended to make, and which I think that I did make, is that there would be no material difference in price between driving a short tunnel with good equipment, and by hand, due to the fact that with a short tunnel you would have a heavier price per foot to charge for equipment. If you drove it by hand you would not have a higher price per foot, but you would have a greater labor charge per foot, and that would depend entirely on how fast you drove it. 6811

I would not consider that these tunnels on the Peninsula system were to be finished a year or so ahead of the Crystal Springs Dam, and other parts of the system that were going to take a considerable time to construct. I would do just as I did on the aqueduct. I would take the unit which I estimated would take the greatest length of time to construct, and begin with that first.

Questioned by Mr. McCutchen.

I said that if you had this equipment, you would be able to make more footage in the same time than you would by hand work, and that there would be no material difference in a short tunnel job, whether you used hand driving, or driving by equipment, so far as the cost per foot went.

CROSS EXAMINATION BY MR. SEARLS.

I think you could install electric locomotive and power drills, and drive Pilarcitos Tunnel No. 1 through at just the same cost as you could if you let 2 or 3 men go in there with hand drills, and take their time about driving it, because you would get through quicker with the power equipment. My idea about that would be that these tunnels would be driven probably not all at once, but we would drive, for instance, Pilarcitos No. 1, and then take the same equipment and drive Pilarcitos No. 2. Pilarcitos No. 2 is 3,400 feet long, and I should think you could drive that in a year. It would 6812
probably take a good deal more time than that to build the Crystal Springs Dam, which might very likely be the prime factor in estimating the date of completion of this work.

It would not be my judgment, if I should find that within the time limit which it would take to construct the Crystal Springs Dam, that I could drive the tunnels by hand, that it would be cheaper than drilling them with power equipment, due to the large depreciation and the excess equipment charges which would be necessarily greater in such an investment for a short tunnel. On the Los Angeles Aqueduct we drove perhaps 3 or 4, or maybe half a dozen of the rock tunnels by hand, out of 50 or 60 rock tunnels. The tunnels that were in what we call soft sandstone, or indurated sand, which I think is the formation which Mr. Dillman refers to near Oakdale, were all

driven by hand. Those were tunnels of soft material, not really rock tunnels at all. When I say sand, I mean a very soft sandstone. Sometimes it is referred to as a soft sandstone, and sometimes as an indurated sand.

Questioned by Mr. McCutchen.

That was the material in which we used augers.

Mr. Dillman: That Oakdale material was largely clay shale; there was not very much sand in that.

6813 Mr. Lippincott: I am not sure that I know the exact material that you refer to, but I know that on the eastern side of the San Joaquin Valley, right along the base of the Sierras, there is a material that is frequently referred to by geologists as the tertiary sandstone. It is a material in which they do a good deal of their exploration work for oil. That is the material that I have in mind.

CROSS EXAMINATION BY MR. SEARLS.

On the aqueduct, wherever the equipment was available for the driving of rock tunnels with machine drills, we used the machine drills, and we used the electric locomotive. I am familiar with the Flannigan tunnel record on the aqueduct. He used augers, and made a very remarkable record, but that is not a rock tunnel. It was in this indurated sand.

In the case of the Spring Valley tunnels, I think I have made a sufficient examination to enable me to say that there was not a very large quantity of soft material encountered in driving them. I have been to each one of the tunnels, and have walked over good portions of some of them, and I am familiar with the general formation of the Peninsula; while a good deal of this rock is perhaps what you might call soft, it is blocky and seamy, and is what I would call heavy ground; it is not ground in which you particularly could do economical tunnel work, in my judgment.

6814 I have been in the Twin Peaks Tunnel. I don't think that I said that it is very easy material to drive that tunnel in. The estimate for the Honda tunnels is a relatively low cost per foot; that is in that class of material. The material through which the Twin Peaks Tunnel is driven is very, very different material, indeed. The Twin Peaks Tunnel is dune sand that has become more or less impacted, and perhaps solidified a little with clay. The tunnels down on the Peninsula—the Pilarcitos tunnel and the Stone Dam Tunnel, are in stratified rock; some of it is hard, metamorphosed, and some of it is soft; it is blocky and stratified and wet. I determined that entirely from the outcroppings. I have worked from 6 to 8 years in the Santa Barbara tunnels in formation similar to them, and I think I know that pretty well.

6815 If I should find that I could drive these Peninsula tunnels with hand labor as cheaply as I could with equipment, that would mean

that my equipment charges, and consequently my indirect costs, would be less. In estimating tunnel costs I was in the habit of putting in for tools, that is such things as cars, drills, and rails of that kind, that is inside of the tunnel, about $2 to $2.50 a foot for a small tunnel.

Questioned by Master.

All of which would decidedly not be eliminated by a change from machines to hand labor. Some of it would be eliminated, as you would get rid of your machine drills.

CROSS EXAMINATION BY MR. SEARLS.

You would get rid of your machine drills, and not so very much more. My experience about electric locomotive is this: That you could use a mule just about as cheaply as an electric locomotive for a short haul, say a quarter of a mile haul, and possibly even up to half-mile hauls; then the electric locomotive comes in.

Questioned by Master.

On the Peninsula tunnels, where they were located close together, 6816
I have assumed that you would use an electric locomotive; they are not a very expensive tool, and you get a pretty fair salvage on them when you are through with them.

CROSS EXAMINATION BY MR. SEARLS.

Referring to Exhibit 133, page 2, I give the cost on Tunnel No. 9 of a length 3,506 feet. This cost data was not the final cost data. At the time this analysis was made the equipment was estimated at $3.75 a foot gross, and $2.50 a foot net. We had the practice of using equipment in a tunnel, and when the tunnel was finished we would transfer it to another tunnel, or to another division. There was always a credit given on the value of the equipment that was transferred; the net price is a price derived by subtracting the credit from the gross cost. This $2.50 would represent about 12% of the direct cost.

The first tunnel in this Exhibit 133, on page 1, is a tunnel that was driven by hand through hard and medium granite, blocky, hand work. Referring to my note there, indirect as per Tunnel No. 9— 6817
that tunnel, although it was driven by hand labor, was charged with the usual 36% of indirect cost where the equipment charges anywhere near approximated the equipment charges in the other tunnels: The way in which that was done, we determined the average indirect cost for the division. This exhibit here shows both ways. The final figures that I have given adds this indirect percentage, which was 36½, and using that you get a figure of $29.94. If, however, we took the indirect charges that are shown there, which do not include such things as trails or buildings, or stuff of that sort, we get the figure of $27.99 instead of $29.94.

In the notes that I have here it gives $5.70 a foot for these net

indirect expenses, and that is just the same as was given for that Tunnel No. 9, which is a machine driven tunnel, so I presume those are average figures for the division. They are not directly applicable to Tunnel No. 6 as far as showing the indirect cost actually incurred in driving that tunnel. In as much as the equipment plays a large part in the indirect cost percentages, it means that the indirect costs on
6818 No. 6 would be less. I would not want to say it would be very much less; it might amount to possibly $1 a foot difference, or a total charge of $28.62. Not $28.62, but out of $29.94. I am guessing at it as far as the ratio between the amounts of equipment in a hand-driven tunnel, and a machine-driven tunnel is concerned.

I should say that in a hand-driven tunnel the only equipment that would be different would be the drills. You would use what you call hand steel, which is a plain bar, instead of a machine, and you would eliminate the air-pipe, that is the high-pressure air-pipe in the tunnel. I don't know that there would be any other difference. The compressor would not be in a hand-driven tunnel, of course. The ventilator fan we always drive with electric motors. I don't know that a ventilator fan, with a motor or gasoline engine,
6819 would cost very much. I have the details of all these equipment
6820 charges if you want to go into them. For a ventilator fan sufficient to ventilate a tunnel about half a mile long, and about 6 x 8 in dimensions, you have got to have a blower pipe, and that, I should think, ought to be from 10 to 12 inches in diameter. I cannot give you offhand prices of the pipe, but I should think it might be 50 cents a foot. I would have to guess at the blower and motor, but I should think they might cost $500. If you had a tunnel half a mile, or about 2600 feet long, you might have to pay $1,500 for pipe, and $500 for a blower and motor. I could give those figures more exactly, if you wanted them. Here is a 12-inch cycloydal bore that cost $354 at Connorsville, Ind. I think my statement of about $500 or $600 to be about fair on that. The pipe would be taken out of that tunnel and used in another place; it would not be all consumed in that tunnel. I would estimate about $500 for the bore and motor,
6821 and about $1,300 for the pipe. Cars and tracks would be classed as indirect costs. As to how many cars would be used in a tunnel half a mile long, that is the thing that illustrates the whole subject that I am talking about. You might say that you would not want over four or five cars, but as a matter of fact, these cars are constantly getting out of repair, and you would find a good many cars in the shop getting new wheels and new bearings. At the south end of the Elizabeth Tunnel we have 57 cars. Speaking of all the tunnels we have to drive in this system, I should think you would want 12 cars. For a tunnel half a mile long to be driven expeditiously and properly by hand labor, I should think you would want 8 or 10 cars at each end of the tunnel. I have seen many tunnels half a

mile long, driven by hand labor, that had that many cars. I have seen them at Santa Barbara. I have not had much to do with mining tunnels.

In Santa Barbara the tunnel was four miles long, and you 6822
would have to have more cars in order to get economical operation over that length. I would never drive a tunnel with a man pushing the car. You pay a man $2.50 or $3 a day to work underground, and the mule would cost you 75 cents a day, and a mule could draw two cars, possibly. I would not double track my tunnel, if I had one of these dimensions; I would have occasional turn-outs. With the number of men that could work in the face of the drifts in a tunnel of that size, I should think it might be a reasonable thing to keep three cars near the heading, one at the heading, and two on a switch, and three cars in transit going out and dumping and coming back; that would make six; then two or three cars extra, either in the repair shop, or available for emergency use. We paid $120 a piece for cars. On this little tunnel I think I said I would use 8 to 10 cars at each end, and I do not think that 8 cars would be about all you could handle in one tunnel. I do not think that would be economical service. I am talking about two headings. I did not 6823
say that I would use the same number of cars on these little tunnels that I would use on a tunnel 3, or 4, or 5 miles long.

I don't know how many cars we had during the driving of the Santa Barbara Tunnel. As a guess, I should say 30 cars. I would drive these tunnels from both ends. Whether it would be more economical to do that than to drive them from one end and drain the water from the lower end, would depend on the tunnel, and the amount of water encountered. In nearly all the tunnels that we drive, we drive them from both ends. When you strike a great amount of water, you sometimes have to abandon the upper end of a tunnel.

On Tunnel No. 6 that I used in my illustration we made practically three feet to the shift, and we worked two shifts a day of 8 hours. In working on the Spring Valley system, you would probably work two shifts. That would be about 6 feet a day for each 6824
face. If you were working both faces, you would make 12 feet a day. That would mean for the entire length of half a mile, or 2,600 feet, 220 days if you worked both faces, or 440 days if you worked one. You could take one shift working at the lower end of that tunnel, hand labor, and finish the tunnel perhaps in a year and a half of elapsed time, which would be in plenty of time to meet your completed Crystal Springs Dam, and other units of the system.

On this Tunnel No. 9 that I referred to in my Exhibit 133, the work was in the same class of rock as this Tunnel No. 6 that we made 3 feet a day per shift in; in Tunnel No. 9, in using air drills, they made 5.8 feet to the shift. I might say that the cost of driving a

tunnel inversely approximates the speed in driving. That is, the faster you drive the cheaper it costs, generally speaking, and you can see very clearly the effect of the equipment on the driving of this Tunnel No. 9 double the speed. We drove at the rate of 5.8 feet. The crew for machine work is somewhat more expensive than for the hand drilling, and you have to have a separate tender for each machine man. He is a helper for the man who is handling the drill.

6825 The compressor is run for perhaps half a dozen tunnels, and you could do that in the Sunol group of tunnels, for instance: Take it at the Pilarcitos Tunnel, I think you could drive four headings from one compressor plant, and at the Stone Dam No. 1 and 2, you could drive two or three headings. That might mean two tunnels; for instance, you could set up in that canyon, that I think they call the Davis Canyon, and drive both ways from the canyon very readily. There is an element of indirect increased cost to be taken into consideration in driving with mechanical equipment. Possibly I could give you some light on that. In this Tunnel No. 9 the labor charge per foot, without the indirect, is $9.15. Now, on Tunnel No. 6 I have this note, and it is rather surprising to me; this is the hand-driven tunnel; excavation, labor, $11.48 per foot. Timber, labor, $2.10 a foot; that makes $13.58 a foot. I guess those figures are all right. We must remember that the machine-driven tunnel made a
6826 progress of 5.8 feet per day, and a hand-driven tunnel made a progress of three feet per day. The cost per day of labor in the hand-driven tunnel would be less, but the cost per foot would be more. The ratio of the direct cost of labor in machine-driven tunnels and hand-driven tunnels would be roughly 9 to 13½, or as 2 is to 3; that is, it would be 50% more in the hand-driven tunnel.

Referring to the cars; we paid $120 a piece for these cars, but they were what were called rocker dump cars. Those are cars that roll on a rocker in dumping, and can be very quickly and easily dumped, and they hold a cubic yard of material to the car.

If you are speaking of Tunnel 6, the excavation per foot of timbered section is 3.514 cu. yds.; for the untimbered section 2.848 cu. yds. Those are the theoretical yardages. If they handled three feet per day at each heading there, they had to handle three times 3½ cu. yds., or 10½ cu. yds., and our cars hold a cubic yard even, that is, packed solid; it would be considerably more in expansion.
6827 Supposing it were 50%, that would be 15 cu. yds. expanded, and would mean 15 carloads a day would come out of that tunnel to the shift, 8 hours.

There would probably be six cars in service, and that would be three trips a shift with the car. Here is the idea: Suppose you have a crew of 15 or 20 men working a tunnel. Mr. Dockweiler thinks about 9 men, but I do not agree with that at all, as I think he left

out four or five different jobs that there were around that tunnel unfilled. You get a crew that is a going machine, that is driving a certain amount a shift, and shooting a certain amount, and mucking a certain amount, and if your car equipment is too short, you have a broken wheel, or something of that kind, and the car goes off the track every once in a while, and you try to get along with that, it will cost you in labor and delay the price of a car in a couple of days, probably. I do not think there is any economy in skimping on equipment charges of that kind. Cars are not alone used just simply for taking out material; when you take your timbers into 6828
the tunnel, they go in in the cars; when you take your powder into the tunnel, your powder goes in on the cars. The men going in and coming out of the tunnel frequently ride on the cars. I am trying to show that there are a good many uses for cars other than simply for taking the rock out of the tunnel.

I have got the blower and pipe about $1700, I believe, then we have got nine cars at one end, which would be $1,080. The tunnel is 2,600 feet long, and the blower pipe is $1,300. A blower and motor $500, and nine cars at $120, $1,080. The powder I put in as 6829
a direct cost. For the track a 20 lb. rail would be plenty heavy enough for a mule-driving equipment, so we can divide that rail charge in half. Dividing the cost of rails in half, I have here for 16,000 feet of track, a figure that looks small to me, $2,877. That makes 20 cents a foot, and is pretty low. Let us put that down at 20 cents. Now, that is $520. That figure includes ties.

Questioned by Mr. Metcalf. 6830

The rails seem remarkably low to me. My notes are as follows: 16,000 feet of 24 inch gage track, 35 lb. rail, $3,437; that is 153.1 tons, at $22.45 a ton; 987 pair of fish plates at 2.6 cents; 6,810 ties, 4 x 6 redwood, at 13 cents; that gives me a total of $4,577, and from that I subtract $1,700 to get down about to the basis of a 20 lb. rail. That gives me $2,877 for 16,000 feet of track; that may be 20 cents a foot.

Questioned by Mr. Searls.

That is for two rails, one track, and I should have something for turn-outs. I think $600 would be a very generous allowance for all the turn-outs.

If you are not going to have the electric locomotive, I insist upon putting the mule in there, as I think he is equipment. If it was an electric locomotive, it would be a direct cost; if it was a mule, I don't know but what it would be a direct cost; he would be charged at so much a day in the shop, but it would be an expenditure to be taken care of and depreciated. We will leave the mule out. 6831

You would aim to get out even on the board of the men, but the cost of all the buildings, the warehouses and the blacksmith shop, and the bunk houses, and the dining room, and the office head-

quarters, would be expenses that would have to be paid for. I never tried to pay for buildings out of the cook house. We came out even on the board of the men, but not for buildings. The outfit to which we contracted our board, I am very glad to say, made something out of it. Both of us really put up the buildings. To start with, we ran our own boarding outfit, and in doing so, we built quite a number of buildings. I don't remember that we were
6832 ever paid for these buildings.

Mr. Ellis: We paid a slight rental for the south and north portal, but of all the boarding houses on the aqueduct, we built 95% of them ourselves. The only thing that we used at all was, I think, the north and south portal, that was all; we rented a few tents to start with, and got our own equipment.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Lippincotet: The company would either contract the board so as to compel the contractor to erect the bunk houses or boarding houses, or it would do it itself, and charge such prices as would remunerate it for the outlay. On this tunnel you have lighting equipment; you would light the tunnel electrically. They do work in a great many tunnels in California without electric light,
6833 but we never found there was any advantage over putting lights in. I do not want to erect a power house to light a few incandescents, but that is some element in connection with the job, the wiring and lighting of the tunnel. I really don't know what the cost of lighting with these incandescents would be, but you might put in 10 cents a foot for it. I don't know that $260 for wiring and incandescents is correct; that is a guess.

You have got to have a blacksmith shop with a lot of blacksmith tools. I think a $100 shop would probably take care of it for a half-mile tunnel.

6834 Mr. Greene: These prices are all installed—they are not the equipment charges, gross, delivered at the tunnel.

Mr. Searls: No.

Mr. Lippincott: On the cost of the blower pipe, my idea about that was that 50 cents a foot would be quite a reasonable price for that pipe delivered at the tunnel. Mr. Ellis, I believe, said that he thought with the hangers that would be the price. Perhaps you can't segregate the cost of installing that from the cost of driving the tunnel, but I would like to look up the price of pipe; 12-inch riveted pipe, 14 gage, price f. o. b. Los Angeles, 36.4 cents a foot. I should think that 50 cents a foot would be a very reasonable price for the pipe delivered at the tunnel without the erecting charge. I think the installation of that one piece of pipe would be carried along with the work, and it would go in as a direct charge.

6835 We have not had anything at all to say about drill steel, or

hammers, or all the small tools. Small tools are not a part of my direct cost. The blacksmith tools might be quite a considerable item, and $100 is not enough to allow for that. Then there are shovels and picks, which is a substantial item. It might be $1 a foot of your tunnel. Drill steel, picks, shovels, hammers, bars, blacksmith tools, and all the small tool equipment that goes into the work, $2,600. Then there is a transformer to step down your high voltage current to about 220 volts, that ought to go in. The power cost comes in in my direct charges. I will make a note and charge for 6836
the power that is received at the plant from the power company. Now I have $6,440.

Take the blower pipe, I don't think that would have a value of over one-third after you got through, so you would write off $860 for that; the blower motor, 50%, $250. On the nine cars I do not believe you would get over two-thirds out of those. Let us divide that even, take 50% off. That is $540, or $600 in round numbers. The rails would be fairly good, but the ties would be gone; there was no labor in laying that; that must have gone into the tunnel direct. I do not believe you would get over $200 out of it. Write off $400 for that. The lighting, globes and small wiring would be practically gone. The building for the blacksmith shop we might use on some other job, so we will divide that in half. Then the small tools I think would be very largely worn out. Picks, shovels, hammers, drill steel, I think they would be. I think your shovels and your picks and your drill steel would wear out in a couple of years in driving half a mile of tunnel, and you would have to write that all off. That makes a total of $4,960. The tunnel is 2,600 feet, 6837
and it is $1.91 a foot. That is the direct cost I used on the Peninsula tunnels.

Questioned by Mr. Metcalf.

I have taken the length of one heading, 2,600 feet, that is $1.91 a foot. The figures that we have been using here should have been about $2.60.

CROSS EXAMINATION BY MR. SEARLS.

Referring to the Bald Hill Tunnel; the direct charges for excavation and timbering there are $14.10; that is with machinery. I 6838
am assuming machine-driven tunnels. I have not considered hand-driven tunnels here at all. If the crew made three feet a shift, 2,600 feet, 6 feet a day, would be 433 working days. I would like to say with reference to this equipment, that you have selected a tunnel 2,600 feet long; you have assumed that it is driven simply from one heading instead of two, which I do not believe would be done at all. You have assumed that it is by hand work, and I have taken machines, so we have arrived here at a figure of $1.91 a foot for equipment that might be chargeable directly to that tunnel, and the figure that

I have been using here is about $2.60 a foot for that item. On the
6839 No. 6 Tunnel, I use $7.65 a foot, and that included roads and trails, and a great many other things.

On my appraisal of the Bald Hill Tunnel, my 40% went about $5.64 for excavation and timbering, but that, of course, included a great many more things than what we have been talking about in the way of equipment. There are some more indirect costs. I don't pretend to be able to predict all the different things that are going to happen, and that you will have to pay for, but I do know that they will come in. I do know that within the last two or three years, right when I was in the midst of bringing tunnels on the aqueduct, and very familiar with all these elements that go into cost, I made an estimate on the cost of driving a tunnel, and I put in every piece of equipment that I could think of, and every accident that I could think of, and allowed for all these things just as we are doing now, and in good faith; the work was done, and these tunnels driven, and my estimate was exceeded very substantially, 25 or 30 percent. That was a tunnel in the Hawaiian Islands. In that case we struck great volumes of water that impeded the work very seriously. It is the
6840 fact that those things keep happening that impress me particularly. If I had to make an estimate of these Spring Valley tunnels that we are talking about, I would put down these direct charges which I am fairly familiar with, and I would add 40% to the estimated cost.

The cost of the water pipe lines for the purpose of mixing concrete, and for the maintenance of camps, was 37½ cents a foot for the entire length of the aqueduct, which is an item that would be incurred. In the case of the Little Lake Division, we picked up the water supply right along the line of the aqueduct and put it into a pipe line, and distributed it along the aqueduct. We practically did not go any substantial distance at all away from the line. The aqueduct, of course, was strung out over about 250 miles. I would answer yes to the statement that it is very much more difficult to maintain our water supply in our camps in a piece of construction strung out over 250 miles than in a piece where the different units are grouped around as they would here on the Peninsula, but I would like to make this further explanation; that these indirect costs that
6841 we are talking about were just about the same thing on the portions of the line near the city as they were on the portions that were remote; they were not altogether the same, but they were approximately so. At Saugus, on the Saugus Division, which was the division next to the City of Los Angeles, we spent $24,000 for water supply. I would not say that the Saugus country was a very barren, dry country, although water is not very plentiful there during the summer months. We pumped it from wells right along the line. We did not have to drive the wells very deep. We perhaps got the water from within 10 or 20 feet from the surface of the ground.

I don't think that it would be reasonable that if you compared my Los Angeles costs on the Jawbone Division, which amounted to 4.8% of my direct cost there, and resolved that into a similar figure for application to the Sunol tunnels, which are right along the line of Alameda Creek, that my water supply would cost $16,450 for driving those five tunnels along the Alameda Creek. We spent $116,000 on the Jawbone Division for water. I didn't use those figures. 6842

Expanding these constituent percentages on the same basis upon which I expanded the indirect cost on the Jawbone Division, gives these figures as applied to the Sunol work, using my own direct costs. I took average conditions. What I meant was, I did not select the Jawbone Division to pick out the cost of these indirect expenses.

It sounds reasonable to me that resolved on the same basis, that my divisional administration on the Sunol tunnels would cost $16,-000, roads and trails $13,000, buildings $11,000, telephone service $3,000, and equipment in building those Sunol tunnels $27,300. I think we are pretty well sustained on this equipment by this estimate we just made here awhile ago.

Referring to the Bald Hill Tunnel; $2600 for a road to get off 6843
to the portals of that tunnel, would be a very moderate figure. You would have easily a mile of road to build around that Bald Hill Tunnel. I think that road probably was built for the purpose of driving that tunnel. The main road from San Andres to Pilarcitos is taken care of elsewhere in the inventory, and all you would have to build would be the branch from that Pilarcitos road over to your tunnel, and from the west end of the tunnel a road over the hill to the east end. As I remember it, the only way you could get in to the east end of the Bald Hill Tunnel is to go first to the west end of the tunnel, and then take a road over the hill to the east end of the tunnel. You have the county road that runs from San Andres 6844
to Millbrae, but I don't think you would travel that road. The road I am talking about is a road from the west portal of the tunnel over the hill to the east portal, and then there is also another road from the west portal that goes directly towards Millbrae, those are the roads I have in mind. I cannot give the names of the roads because I am not familiar in detail with them.

Mr. Ellis: Road No. 4 is a road from the entrance to the Bald Hill Tunnel to Millbrae. It is a separate road in the inventory, and is so appraised.

Mr. Lippincott: I did not look at the inventory to see what roads were appraised before I put this percentage on for indirect costs. I did not assume we would have to build all these roads, and I did not use comparative indirect costs based on jobs where we did have to build all the roads. On the Jawbone Division the public highway ran right along the base of the hills, and we built roads from

the public highway back to the line of the tunnel. In a great por-
6845 tion of the line of the aqueduct the public road of the country ran quite close to the aqueduct, and was in existence before we began work. We built a great many roads back in the mountains for construction purposes. We spent a large amount of money for that purpose. In the case of the Santa Barbara Tunnel there was a road up into the Mission Canyon, and we built a road from that into our tunnel camps, and built trails over the hills. Those branches would average possibly two miles in length.

I do not think that the branches from the regular Spring Valley roads which have been appraised in this inventory would be two miles in length at the maximum. We are talking about the Bald Hill Tunnel, and I see here on this map that I have two branch roads, one going down to the easterly portal, which is .47 of a mile in length, and one going to the westerly portal which is .5 of a mile in length. I don't know whether both of those roads are appraised in the inventory or not.

Mr. Greene: One of them was, I think, and the other was not.

CROSS EXAMINATION BY MR. SEARLS.

It would be exceptional to find a road more than half a mile in
6846 length that we would have to build. In the case of the Sunol tunnels I am not so sure that the road building would be so very infrequent. You have to deliver materials like tunnel timbers, which are heavy, and cement and gravel, right to the portals of your tunnel. I would not think your roads would have to be over from one-quarter to one-half a mile long in the Sunol Canyon.

On the face of it it sounds like a reasonable statement to say that you could scarcely use the aqueduct road construction costs as a fair basis for comparison with similar roads on the Spring Valley system in view of the fact that these main roads are taken care of in this inventory, but you ought to take into consideration that there are 160 out of the 220 miles of aqueduct construction that is on quite an open, smooth plateau; the road construction costs on three-quarters of the length of the aqueduct is a very simple matter, while on the other one-quarter it is quite an expensive proposition, like on the Jawbone Division. In the case of the Peninsula tunnels, the country is all mountainous. That is also true of the Sunol Canyon. In the case of the Honda Tunnel, you would not have any roads at all to build.

Where we had mountainous divisions on the aqueduct, our road building was much more severe than it would be here. The indirect
6847 costs, 32%, on the Jawbone Division were not among the lowest on our system, as our indirect costs got down as low as 22% on some divisions. The Jawbone Division was one on which the cost of the work was very great. These indirect costs were distributed over the

very high direct costs. For instance, the cost of work on the Jawbone was $2,401,000, while the next division to that in cost was the Grapevine Division, where the cost was $1,680,000. These equipment charges and road charges, and things of that kind are not fixed, and when you have a large direct cost to figure them over, it runs down the percentage. That is the occasion for the low percentage on the Jawbone Division, I should think. I would say that the smaller the unit of construction, other things being equal, the higher the indirect cost might be.

Referring to the Bald Hill Tunnel, that would mean that each of these items for the construction of a small tunnel like that would be even larger than the figures which you read to me here. If you had one tunnel 1,000 feet long, and another tunnel 2,000 feet long, and you had to build a road into them, or a telephone line, or buy blacksmiths' tools, the charge per foot on the short tunnel would be greater than it would on the long tunnel. The fact that you are within a short distance of Millbrae on the Bald Hill Tunnel work, would not help you out much on the water game if you had to lay a pipe line from there. 6848

Take that Bald Hill Tunnel: When I was there I went with Mr. Lawrence, and I noticed at the eastern end of the tunnel the ground had slipped—a decided slip that had moved some of the buildings—and interferred with some of the structures at that end of the tunnel. That, of course, is a slight thing, but if you were driving that tunnel, and got underground, and you had a movement such as would be indicated by this thing that I speak of, it might be the source of a very severe expense to you. Now, just that thing happened at the Santa Barbara Tunnel. We were in 2½ miles, and we had a slip of ground that cut off a mile of that tunnel, and rendered it inaccessible for nearly six months' time. After trying most everything to get through that slide, we finally had to give it up, and run a drift around the side, and that slide still remains in that tunnel. It is things of that kind that are apt to happen that I am referring to.

I assume that in estimating the cost of reproducing the Spring Valley structures, that it was fair to assume that you would meet with a heavy slide in each tunnel, and probably kill several men. We consider that we had a very, very fortunate record in that regard on the acqueduct; we killed perhaps 15 or 20 men in constructing all those tunnels. We had very, very careful men, but you cannot prevent accidents in these tunnels. You can do a great deal toward mitigating them by taking care of your crews, and taking all 6849
precautions reason dictates.

Questioned by Master.

For this Bald Hill Tunnel I account for such things as that in my figure of $25.36.

Questioned by Master.

Mr. Hazen: I include such contingencies as slips of earth and accidents to men in my figure of $27 for the Bald Hill Tunnel. I do not figure that in my final overhead. Of course, that would not occur in every job, but the risk of its occurring is intended to go into that cost, and I make allowance for it in some way.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Lippincott: Casualty insurance would take care of the lives of the men on a small job, but on a big job I do not think it would. The actual cost from injuries on the aqueduct was 26 one-hundredths of 1% of the payroll. Those are my figures. Before these liability insurance laws went into effect, we could not get insurance as low as 1% of our payroll; now it would be about 12%
6850 or 13% of our payroll. In view of our aqueduct experience, it would not have paid to carry insurance. That included 120 tunnels, and, of course, that 26 one-hundredths of 1% was for all the work, including all the outside work that had no such risks in it that the tunnel work had.

Questioned by Mr. Greene.

It did not cover the accidents in tunnels alone, but the accidents over the entire construction. That is, over the entire aqueduct, and two-thirds of that work was outside work.

CROSS EXAMINATION BY MR. SEARLS.

It is all a question of speed as to whether it would cost more to drive by hand labor from one heading than it would to drive from two headings with machine drills, as I have suggested in my appraisal of Bald Hill Tunnel. As I showed you, Tunnel No. 9, which is driven with machines, was driven at the rate of 5.8 feet per shift. Tunnel No. 6, which was a hand-driven tunnel, was a shade under three feet per shift. The cost per foot is very directly related to the speed with which the work was done, and consequently I thought that the machine-driven work would be the cheaper.

6851 I remember that we figured that the labor cost per foot on the hand-driven tunnel was about $11 and some cents. I figured it would take them about 433 days to do it, and that the ratio would be about $13.50 to $9.15, which is about three-halves for the direct cost. That was for labor. The same ratio would not apply to the other items of direct cost, such as powder. I think the powder per foot would stay about the same, and the amount of powder per foot, as I remember the figure that Mr. Dockweiler used, I think is too low.

If I understand your question, I think it would be entirely fair to me if you applied the ratio of $13.50 to $9.15 to the entire direct

cost. I figured that the labor cost per foot was 50% in excess for a hand-driven tunnel. Now, if you allowed 50% excess for powder, 6852
lights, and all that sort of thing, it would increase the cost per foot of driving the tunnel, but I don't think there would be that increase in material.

In driving the Bald Hill Tunnel with machinery you get $12, and $2 for timbering, which would be $14, and 50% of that would make it $21 as the cost of doing that kind of work by hand labor. In view of the fact that the cost of powder and so on would not increase as rapidly as the labor charge, $21 is probably an outside figure. That is excluding lining.

I have studied the matter of the amount of overbreak that occurs in tunnels of this character a great deal. In a rock tunnel that is not timbered—we are only considering half of the Peninsula tunnels timbered—it is impossible to drive a tunnel true to the line. The rock will break to the seam or to the fissure, and you will have 6853
a jagged and irregular perimeter to your tunnel. As I remember it, we used to think that we were getting along pretty well if we could drive a tunnel that did not have over from 5 to 10 percentage overbreakage as compared to the yardage in the tunnel section, except in the very short sandstone tunnels where you could trim them with a pick; otherwise, you would have perhaps from 5 to 10 percent overbreakage as compared to the volume of rock excavated. That would very often be 50% of the theoretical concrete yardage; that is, if it took theoretically a yard of concrete to the lineal foot to line a tunnel, you would actually put in a yard and a half. That is a very substantial thing to keep in mind.

I do not estimate the quantity of my backfill on the basis of my total excavation per foot of tunnel, or on the basis of the lining per foot of tunnel. The section of the Bald Hill Tunnel is given as an egg-shaped section inside of a timbered section that is quadrilateral in its character. The concrete lining that I figured on was the theoretical yardage in this 9-inch ring. The backfill that I figured on was the filling of these corners in the bottom and the top of the tunnel. I figured on filling that with a very lean mixture of concrete, 1-6-12. We used concrete in our backfill on the Elizabeth Tunnel on the aqueduct. That was the only tunnel where we made a distinction in the mixtures. In the other tunnels we put the regular straight good concrete right back to the limit all around. In the Elizabeth Tunnel some of our overbreakage was so severe and so big 6853½
that we made a special run of very lean concrete to do the backfilling with. Our excess concrete in our tunnels would run about 50% of the theoretical yardage of concrete to line the tunnels.

Questioned by Mr. McCutchen. 6854

I mean that that was about uniform as I remember it.

CROSS EXAMINATION BY MR. SEARLS.

We did not use a dry pack of clay and dry earth in a great many of our tunnels, or cord wood. We wouldn't think of putting anything like that in a tunnel that was to be lined with concrete. In a railroad tunnel where you are timbering we sometimes put the cordwood above the timber sets. I have seen that done. I believe in the Santa Barbara Tunnel, where we have caves that would run about as high as the ceiling of this room, we would block that right up with tiers of 6 x 6 and 8 x 8 redwood timbers to hold that in. We didn't fill it with concrete; a hole like that we could not fill with concrete. I have seen them driving the Twin Peaks Tunnel where they leave the timbers right in and place the concrete forms in front of them. We had a computation on that the other evening, and we were very much interested in it. I don't know just what would happen to that.

Questioned by Mr. Cutchen.

The break in the Santa Barbara Tunnel which was as high as this room was caused by the character of rock. The rock has been shattered and folded by the folding of the earth's crust. It has been broken up into seams. It is wet. In spite of that, it will get away from you every once in a while, and when it gets away from you you have a very serious time in picking it up. I am satisfied from my knowledge of the formation we have in this peninsula that you
6855 will have those conditions out there in driving tunnels in the peninsula. That is what I call running ground, heavy ground, and blocky ground.

CROSS EXAMINATION BY MR. SEARLS.

I did not study or read any of the Spring Valley records showing the experience they had in driving these tunnels. I did not find anywhere that they had used either brick or concrete for backfill. The only place I had a chance to study underground conditions was in the Sunol Canyon, and I spent a day in a railroad tunnel there, watching them take out crushed timbers and picking up that ground in this heavy shale and slate rock over there. I saw it was a thing that I was familiar with, and that it was the same old problem.

As far as I know, I only had the indirect statement of Mr. Schussler, which Mr. Metcalf gave me, as regards overbreak in the construction of these tunnels. This information was procured after I had made my estimate. It was remarked that some of these corners were filled with rammed clay and rock instead of concrete. I think that would be just about as serious a proposition as putting in a 1-6-12 mixture of concrete. To ram in the rock and clay and then pack it in, and make a puddle clay on top of those arches is as expensive as filling in with concrete; at any rate, I didn't know

about that until after I had made my estimate. The thing I understood I was to do was to come up here, and as a matter of judgment, and on my own personal initiative, make an estimate of the cost of duplicating these tunnels. That is what I did. My estimate would be far too low if I were expected to put in every possible contingency 6855½
that ever happened in any tunnel as the probable cost of constructing these.

NINETY-FIFTH HEARING. FEBRUARY 11, 1916.

Witnesses: J. B. LIPPINCOTT for Plaintiff. 6856-6859
ALLEN HAZEN for Plaintiff.

(A corrected copy of Exhibit 123 was offered by Counsel for Plaintiff in place of the original Exhibit 123, but owing to the objection on the part of Counsel for Defendants, who stated that several things had been omitted from this corrected exhibit that had been in Mr. Lawrence's original exhibit, it was determined to bring the original exhibit into court in order to ascertain to what extent any amendments or change is desired therein. The matter was allowed to stand in abeyance for the present.)

Witness: J. B. LIPPINCOTT for Plaintiff. Lippincott

CROSS EXAMINATION BY MR. SEARLS.

I stated yesterday that the wages and labor costs on machine work in tunnels would probably be considerably in excess of the wage and labor cost on the hand work, only that it would take a greater number of labor days to do the work by hand. That is, the cost per day of running a machine crew would be greater than running a hand crew for labor, but the machine crew would do a greater footage.

Referring to Tunnel No. 6, page 1, Exhibit 133; that shows that 6860
the direct cost, exclusive of the lining, was $15.05 per foot, whereas, for the machine driven tunnel, on page 2, the direct costs, exclusive of lining, are $13.12 per foot, which would indicate a very much lower ratio. It is a comparison for excavation and timbers in the hand driven tunnels $15.05 a foot, and in the machine driven $13.12 a foot. They were both of the same size. Speaking of the direct costs, of course we were talking about labor charge, and I was going to correct my figures some, but the 50% increase was for labor, and this is for all charges, the whole thing taken as an entity. Of course, there may have been some difference in the rock, but not much.

6861 Those two tunnels were selected for purposes of illustration, not because they demonstrated this point that I am speaking of. In this particular case they happen to show just these figures, \$15.05, and \$13.12, and they seem rather rational, too. The indirect cost of \$7.65 on this Tunnel No. 6 included the indirect costs on the lining. The indirect costs on the work, exclusive of the lining, would be 40% of \$15.05. That isn't what I used there, but when you say 40%, I suppose you refer to my Spring Valley estimate. The actual indirect expense on this division on the aqueduct was 36½%, and that would make it for the indirect costs on the excavation and timbering alone \$5.50.

Yesterday we got an indirect cost of \$1.91 on our one heading tunnel, driven by hand, excluding a proportionate cost of roads, trails, and accidents, which I could not estimate. I think the only estimate which would be increased if a two heading tunnel were driven would be the blower and blower motor, the cars and blacksmith outfit. You have not enumerated all the things that I consider to be covered
6862 by this 40%. Roads, trails, and accidents, aside from those that you enumerated are not all of the things that are covered by that 40%. I do not mean to say that these percentages would be identical on both these jobs, but here is what the 36½% included on the equipment: Surveys and general engineering, and pipe lines for construction and maintenance. This was a water pipe line for a domestic water supply, and the mixing of concrete, and the supplying of water for the work; telephone lines and their maintenance; roads and trails and their maintenance; that not only means the building of the road, but upkeep of the road and the maintenance of it. Now, our buildings amounted to 2% on the direct cost. Low tension power lines; these are temporary power lines that are built for power and light. Provision administration; miscellaneous tests; lost cement sacks; lost cement sacks amounted to .3 to 3% with us. Patrol or policing. I do not consider that lost sack percentage properly included in cost of the cement. The price on \$2 a barrel on cement was the net price, but there would be a loss of cement sacks. We found that we could use the sacks, as I remember it, from 3 to 4 times before they would be torn or lost. Then miscellaneous losses, and expenses of reorganization.

6863 Questioned by Mr. Greene.

It is the fact that during the doing of this particular work we ran out of funds and had to largely close down, store our outfit, dismiss our organization in part, and then start to work again. That is what I mean by expenses of reorganization.

Questioned by Mr. Searls.

It is quite possible that that would happen in the construction of the Spring Valley system if you strike a period of financial depression.

Questioned by Mr. McCutchen.

The element is also present that if you had ceased work during winter you would have to get your organization together again.

Questioned by Mr. Searls.

This thing happened to us in spite of the fact that we had an actual contract for the sale of our bonds.

I think it might cost you $400 or $500 if you were to attempt to work in the winter to put up a building to store cement in, and here 6864
you are talking of building a tunnel amounting to $2600.

CROSS EXAMINATION BY MR. SEARLS.

My appraisal is not necessarily based on the assumption that we would have a financial breakdown such as we had at Los Angeles, where we had to lay off our entire organization practically. The only thing I am trying to prove is the fact that all these things are apt to happen, and in addition to that there are other things that may happen. In my work in the Hawaiian Islands it was a tremendous volume of water that happened to us. The same thing is true of the Santa Barbara Tunnel. It is all these things that have to be paid for.

I find they had a serious time with the Merced Tunnel. They had a cave that actually stopped the work at one heading. In the Davis Tunnel—I was looking at photographs of that last night, in 6865
which the heavy ground was shown with crushed timbers, and the tunnel had to be in that particular place and retimbered. I did not find in the Davis Tunnel that they had a great deal of difficulty in handling the water, or with any other tunnel, excepting the Merced Tunnel. It is not a correct assumption for engineers to make in making appraisals for tunnels such as these, and in the country where these tunnels are found, that there would not be any great difficulty in handling water. I would be afraid to make any such assumption as that, particularly with reference to the Sunol tunnels. At Sunol it is really a stratified rock, and the stratification approaches the vertical, and the spaces between the strata are filled with water in all probability, and as you proceed, these have to be drained off one after another. That indicates something that you don't find in almost any tunnel construction in the matter of handling water. I would rather drive a tunnel in granite than in almost anything else that I know of, excepting this material that Mr. Dillman was talking about yesterday, indurated sand. I would rather drive a tunnel in a medium hard granite, where you don't have to timber, where you are not troubled with caving, and where you are not liable to accidents from falling rock and from caves.

In the Twin Peaks Tunnel they are above the water plane, and 6866
they have sand. I would consider that if that tunnel were driven skillfully it can be driven cheaply. I think a little in the way of error or bad judgment there might cause a very serious expense. I think

they might have a cave that would go clear to the surface of the ground. That comes to the proposition of hiring skillful tunnel men. That tunnel is timbered solid with 12 x 12 timbers. I have not heard that they had any great difficulty in handling water at the west end of the Twin Peaks Tunnel; they are above the water level.

Referring again to the list that I started out to read: I had gotten down to expenses of reorganization. After that is concrete replacement; that is where the cement has proven to be unsatisfactory, or where there was bad work in putting it in, and you had to replace it with other work. That was absolutely not largely due to the Tufa cement that we use. It is a mistake to say that much of the defective concrete in the aqueduct was due to Tufa cement. The cement that was manufactured by the aqueduct we did have some trouble with, but the addition of the Tufa to the cement seemed to take up the free
6867 lime, which is the cause of most of the trouble in the straight cement, and to be a distinctly beneficial element in a cement of that kind. I do not now recall any serious trouble that we had with the Tufa cement. We had some trouble with our own.

If you purchased Portland cement from the regular companies, as I assumed that it would be purchased here, you possibly would not have as much trouble as we had, but you would have some. The manufacture of cement is a delicate process. It is something like the tempering of steel. It is not an exact chemical science. It is a combination of chemistry and mechanics that cannot be worked out in an absolute manner. You are apt to have those troubles with any cement, and we have had them with all cement.

The next item is equipment expense, which amounted to $1.31 a foot for the entire 200 miles of the line.

The next is passenger transportation on labor. This passenger transportation on labor did not amount to considerably more on this strung out project than it would on a more or less consolidated pro-
6868 ject, like the reconstruction of the Spring Valley works. On the contrary, we made a very rigid rule that we would not pay for passenger transportation on labor, and we did not do that until we got down toward the end of the job where the labor recognized that the duration of the work was to be very short and ceased going out there. During the latter part of that work we had to pay transportation on labor, and that amounted to $10,073. The aqueduct was built principally by hobo labor, very largely at first; that is the kind of labor that usually does build public works. By that I mean the common labor. I am not referring to mechanics, or even to miners. Toward the end of the work we acquired a good many Spaniards, and they were very good men. Also a great many Austrians, and people from the Balkan country; they were distinctly not hobo labor, but men who stayed with the work, and who saved their money.

I would hardly think, speaking of this hobo labor, that as a

general rule that would be less efficient than a properly organized crew of laborers, such as would be gotten up by a contractor. We were very fortunate at the time we started our work, along about 1907 and 1908, in that there was a general condition of depression, and we were not only able to buy equipment cheaper, but we were able to select through a great range the principal assistants we wanted on the job, and there was an abundance of labor. It was in 6869
very distinct contrast with the work I had to do on the reclamation service along from 1905 to 1906, when there was a big demand for labor, and when it was necessary to ship labor from remote points. I remember at the Laguna Dam, at Yuma, that labor was shipped by the contractor from Pueblo, Colo., to Yuma. The cost of that work was very greatly increased, and exceeded the estimate very largely, because of those labor conditions, which, because of the heavy demand at that time made for inefficient labor. The character of the labor that you will get on public work, a big job such as you are talking about, almost inevitably has to be made up in the day-labor branches of that drifting population I speak of, unless you employ the people who are generally referred to as Greeks, or perhaps the Spanish labor.

I have a general heading entitled "General miscellaneous expenses "and operations"; it has certain debits and credits. Under the debits are passenger transportation, water investigation, sundry adjustments —that is a small item, $6,000; subsistence losses, unadjusted freights —that is where we have not settled freight bills because we claimed the freight should be given a different classification—that was $146,000; stock service; maintenance and operation losses; miscellaneous operation adjustments; Tufa plant account debit; then a credit on that account was given; discount on bills; building rentals; water sold; equipment rentals; hospital service; the sale of light and power in Owens Valley; and a credit from our power generating expense—that amounted to a net debit of $277,000.

The Tufa mill debit I do not charge up in the list I have been reading as an indirect expense, but in that overhead discussion I 6870
had with Mr. Hazen, and which is filed as an exhibit in this case, we did charge that cement mill debit as an indirect expense, just as this Tufa debit is so charged here. That was merely a bookkeeping entry, and not an actual indirect expense that was incurred. If anything, it was a part of the cost of the cement, and was properly chargeable to the direct cost of manufacturing that cement, but that was not done. In view of that fact, I should think it was probably not a proper charge under the classification that I call indirect expenses, but it would be a great labor to take that $890,000 and go through all our unit costs and increase the unit costs in such a way as to take care of that. When you are all through you have arrived at the same total cost.

The situation with reference to the Tufa cement was this: We 6871

made an estimate of what it would cost to blend that cement, and then we made a great many thousand barrels of it. At the end of our job we found that that estimated cost was too low by $59,000. The cost of the manufacturing of the Tufa cement, according to our estimate, was charged directly; the balance on the books—the $59,000, at the end of the job was considered as an indirect expense.

In this cost analysis there is given on the second page an item of $883,000 for the cement plant. It is marked "Net debit". That amount is arrived at in this way: The cement was issued, we will say, at a cost of $1.50 a barrel; we ran through the job and used a very great number of barrels of cement, and at the end of the job we found we had not charged enough to these different pieces of work for the cement that was issued from our mill. That item of $883,000 was made up in that way. You are perfectly correct in saying that that $883,000 ought to have been charged as a direct cost to these various pieces of work that this cement was used on, but it would be a very difficult thing now to go back through the accounts and distribute that. In this account I have just read, it is considered really as an indirect cost, but it is not included in the indirect cost that I used to figure this 33% of indirect for the aqueduct—the cement mill
6872 is eliminated. When Mr. Hazen and I made this comparison between his figures for indirect expenses, which he calls construction and supervision, with mine, we did consider this $883,000, and I think it is proper that it should be considered.

I considered that that was one of the things that was taken care of by this 40%, just the same as if you would buy a lot of cement and have it stored in one of these warehouses, and the roof would leak, and your cement would spoil, and you would charge it as a loss; you have to take care of it somewhere, and I think it ought to be taken care of in the indirect expenses. You are talking about an aqueduct situation where we were making our own cement; this is a purchase price. The thing that our mill did for us down there,
6873 that justified its construction, was in breaking the combination selling price on cement. We bought cement for $1.05 at the mill; when I am figuring unit costs on this charge I am using for illustration I am taking that very cheap cement in as a part of those unit costs. I do not assume that the combination is broken up here when I get a price of $2 a barrel for cement. If you want to cut out this debit on account of the cement bill of $800,000, and you would be willing to increase the price of our cement used on the aqueduct 50 cents a barrel, I think you would get the worst of it on the estimate.

I am figuring this job here on the proposition of material furnished here, at prices here, and labor costs here, and all that sort of thing. The indirect costs on the aqueduct are not the only thing I am using directly here; I have a great mass of information that I consider one of my most valuable possessions as the result of about 7

or 8 years of work down there on a great variety of work, and I am using all of that.

The country adjoining the Santa Barbara Tunnel I would expect 6874 to find very much more gassy than on the peninsula, but I don't think that would be so true of the Sunol region. I would expect to find some gases over there, the sulphurated hydrogen gases. I have never read any of Mr. Schussler's reports covering the construction of these tunnels. I was looking through his photographs last night; that is the first thing of the sort I have seen. No one connected with the Spring Valley Water Co. informed me that they had found gas in those tunnels at the time they were constructing them. That is purely a hypothesis of my own based on the experience I have had in other sections. I have seen sulphur gases in the country around Sunol. There are some sulphur springs on the road between Niles and Sunol, I think.

On my reproduction of the Merced Tunnel, page 33, Exhibit 133, I did not assume that there would be great difficulty in driving 6875 Merced through its entire length on account of water. I assumed 1536 feet of wet tunnel, wet sand. I went out there and walked over the tunnel, and particularly saw Merced Lake, which is at an elevation above sea level. I knew that this tunnel was driven at its lower end to approximately a few feet above high-tide level. I saw the sandy character of the country that the tunnel was driven through, and I particularly noticed that there were a number of what we call cased wells that have been put down along the line of the tunnel, evidently for the purpose of pumping, or of handling the water. Taking those things into consideration, I made that estimate. In addition to that, I might say—and it is a correction of a former statement—this morning and last evening I looked up some of these old records for the Merced Tunnel that Mr. Dockweiler had referred to, and found that they did have a profile that showed the levels of the water in this place where they had driven this tunnel, and while I did not make a very complete study of the profile, I did endeavor to check up this statement, and I found that my estimate was reasonably right; I also found they had reasonable caves in driving that tunnel. I should have said that there were about 1500 feet of tunnel driven where the water plane was encountered.

I did not find in this statement, or in any profile sheet, that the 6876 Spring Valley Co. had driven wells every 50 feet to an average depth of 300 feet. I have a cost of $26,000 for driving wells, and handling the water situation in that tunnel alone. The tunnel was 2,536 feet long, and the total cost per lineal foot $39.50.

The Master: The cost of his wells per foot of tunnel he gives here as $8.80.

Mr. Metcalf: The total cost of the tunnel was $120,195; in round numbers it was $120,000.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Lippincott: I figured the handling of water there would cost 20% of the entire cost of the structure. I might say, in justification of that, that I was on the Board of Engineers that had just that problem to consider in Los Angeles County for a tunnel driven in sand below the water plane, and that is just what we did. That was the tunnel on the outfall sewer near Inglewood. It broke the contractor
6877 —at least, he threw up the job.

I don't know whether I consider the water conditions at Merced as bad as the water conditions at Los Angeles in the case just referred to. I knew that that condition was a serious one down there. The contractor had tried to drive the tunnel without lowering the water plane. He could not do it. Three of us went down there as a board
6878 of engineers, and went over the proposition, and recommended the handling of it in this manner, and the tunnel was successfully driven. I am not sure that the wells were driven every 50 feet, but it was about that. It is a very serious thing to drive a tunnel in sand below the water plane; it is a very hard thing to do. I never drove one with compressed air, and know nothing about that method. It might be very much more economical than driving it by sinking wells every 50 feet to take care of the water. There were about 6 or 7 wells, I think, driven at Merced, and I think I assumed about 30. I did not find any indications of 30 wells having been driven out there when I went over the line. I have this plan for the driving of that tunnel, but I confess I don't understand it. They evidently were in
6879 some kind of trouble there with this tunnel. I understand this to be the main line of tunnel, and there are drifts and borings that were carried on around there.

Mr. Dockweiler: They were all taken care of in the inventory.

Mr. Metcalf: The cave was not taken care of in the inventory.

Mr. Dockweiler: In the preparation of the inventory I had that map made for me, and as the result of the best conclusions that we could draw from the data, we arrived at the lineal feet of drift as set forth in the inventory; it was the best guess that we all could make.

Mr. Searls: The inventory shows that Merced Tunnel is 3,036 feet in length; in addition to that there were 773 feet of drainage drifts, and 173 feet of drainage shafts.

Mr. Lippincott: I didn't figure on those.

Mr. Metcalf: We included those in making up our comparative estimates.

6880 (Here ensued a discussion as to the number of wells actually driven on the Merced Tunnel. A profile showed five, and the witness called attention to a notation or reference to well No. 6, with the conclusion that there must have been six wells.)

CROSS EXAMINATION BY MR. SEARLS.

Mr. Lippincott: The Stockton Street Tunnel, in San Francisco, 1913, was the first place where the process of shooting concrete in tunnel lining was done. I think it is a saving in the cost of reproduction. I experimented with that thing myself, about 1910 and 6881
1911, and I talked with Mr. Van Horn, the man who invented the process that was used on the Stockton Street Tunnel. He was the inventor of the equipment that was used on that tunnel, I believe. It is possible that that process might have been used in the lining of some of these tunnels in 1913. It was a new thing just being introduced then, and is a patented process. The owners of these patents charge royalty, and they charge just whatever they can get in the way of royalty; that takes some of the saving away.

On page 6622 of the transcript, where I refer to these Los Angeles tunnels, and have listed the ones I have used in my inventory, I do not think I have given all the Los Angeles Aqueduct tunnels there that I considered in any way comparable. We had a great many tunnels, and without knowing or thinking just what the particular cost of driving those particular tunnels was, or selecting tunnels that were either high or low, I picked out the tunnels that I happened to know were tunnels in ground that was soft, rocky granite, more or less wet, and of similar size—the smallest tunnels that we drove—and presented them.

I think that tunnels driven in medium hard granite would be fairly comparable so far as cost per foot goes. I remember tunnel 1-B south, on the Little Lake Division. When the work drew to a 6882
close on the aqueduct, I selected certain typical pieces of work and made careful cost analysis of it, and those analyses I have in the shape of memoranda. That tunnel 1-B south is not in it. If you would give me a little time, I could get it for you out of the cost records. I remember the ground there was pretty soft stuff.

Tunnel No. 1, on which you gave $10.35 a foot for driving and timbering; No. 2, on which the cost of excavating and timbering was $12.28, and No. 5, on which the cost was $13.14; I would like to say with reference to those tunnels which you have selected that they are the most shattered tunnels that we drove in what we call the Little Lake Division. The first tunnels were in material that was quite soft; that material kept getting harder and harder as we went 6883
south, clear through the Grapevine Division. The soft materials were in the first tunnels, and the harder materials were in the tunnels up to about No. 17.

Tunnels 50 I, K & L, were driven in loose sand. We laid them out first as a cut, and then afterwards drove them as a tunnel. They are in the extreme northern end of the Antelope Division, and have a slope of .0018. I thought I had everything there was there, but I don't seem to have them.

Referring to Tunnel 50-I; the cu. yds. to the lineal foot of excavation of the timbered section was 3.51 cu. yds., and of concrete a yard. On these tunnels we had located the line as a cut and cover, and we decided to shorten the line and drive these tunnels. It was
6884 through a sand that was dry. In the timbered section the outside height for the excavation was 10 ft. 4 in.; the width would be 9 ft. 2 in. Inside of that you place your timbers and your concrete. It was one of the smallest size sections we had to drive.

The Master: The same dimensions as this Tunnel No. 6.

CROSS EXAMINATION BY MR. SEARLS.

That figures out $6.15 a foot on a per yard of sand excavation; 3½ yards to the foot—it will be considerably under $2 a yard. On 50-K the excavating charge would be $1.53 a yard.

On the Merced I use $10 a foot for excavation, which approximates about 2 yards to the foot. On the Honda, which is a tunnel above the water level in sand, I use $6 a foot, which would be comparable with this $6.15, $5.34, and $6.03, in the sand tunnels that you have referred to as 50 I, K & L. The yardage per foot in the Honda Tunnel is 1.425, and that would make the cost per yard $4.20,
6885 as against $1.50 and $2 on these tunnels. I estimated that the Honda Tunnel will be driven in sand at that price, but I found out since that according to the schedule something like half of it was in rock, so that my figures on the Honda would be somewhat low. I also found out in looking at the photographs that instead of the Merced Tunnel having a brick lining 9 inches thick, it had a brick lining 12 inches thick.

Mr. Metcalf: It was not all the way through. There are sections of it that were 12 inches. That is shown from the Progress Profile, and not from the photograph. It was where they increased the rings at some points.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Lippincott: On the Santa Barbara Tunnel we encountered both the explosive gases and the sulphur gases.

Counsel for Defendants then read the following from "Engi- "neering and Contracting," Vol. 38, No. 18, dated October 30, 1912, "page 482.

"Mr. J. B. Lippincott, of Los Angeles, as consulting engineer, "recommended the project herein described. Upon the adoption of "Mr. Lippincott's recommendations, the City let contracts for the "construction of the tunnel. The contractors drove a little less than
6886 "50% of the tunnel, and were then forced to relinquish their con- "tracts by the Water Commissioners and City Council of Santa Bar- "bara. The inability of the contractors to carry on the work satis- "factorily was due in part to the adverse conditions, such as water "and gas, which were encountered."

Then further on it says:

"All tunnels present some peculiar and particularly adverse con-"ditions on account of gasses, water, loose formations, or swelling "ground. Santa Barbara's tunnel has been no exception to this rule, "and has presented many expensive and difficult problems."

Mr. Lippincott: That is true.

Mr. Searls: Then it goes on and states as follows:

"At the heading near the oil sand, gas was encountered in larger "quantities, and finally when this formation was opened up, a large "amount of gas accumulated in the tunnel immediately following the "blast, and was accidentally exploded by the workmen. The force of "the explosion was terrific, and those not severely burned were hurled "along the tunnel."

Mr. Lippincott: That is correct.

Mr. Searls: And also the following:

"This was an exceptionally large quantity of gas, being about "25,000 cubic feet."

Mr. Lippincott: We did not run into any oil sand, but where we neared the oil sand was probably in the crest of an anticline that
we were drifting. The Santa Barbara Tunnel was the most difficult 6887
tunnel that I have had anything to do with, and I do not think the tunnels up here would cost so much.

In reproducing the Spring Valley system, I did not use any 6888
brick. I figured on the cost of lining some of them with brick as an alternative proposition, but I didn't use those figures in the final estimates.

Mr. Greene: If his honor were to decide that those tunnels were to be reproduced as brick lined tunnels, I intend to present Mr. Lippincott's figures, as indicating the cost of brick lining, for whatever they are worth.

Mr. Lippincott: I have quotations here that I got from the McNear Brick Agency, and I have a copy of your (Defendant's) letter, too. They are the people you got yours from. They gave me $7.50,
but I am willing to admit that my brick figures are 50 cents a thousand 6889
high.

Questioned by Mr. Greene.

I got figures on brick in San Francisco, and I suppose you would have to pay freight on the brick from San Francisco to Millbrae and San Mateo. After discussing the subject further, I found that the San Jose brick moving into San Francisco could be stopped at those points without that additional overcharge.

Questioned by Mr. Searls.

I use the same price on cement that I do in reproducing the concrete dams.

Questioned by Master.

Referring to my schedule, page 11, Exhibit 133; brick f. o. b. net,

there is $7.50, and my price throughout these tunnels f. o. b. net is $7.50. I think $7 would be a fair figure. I don't remember just what the difference would be, but I will figure that out.

Questioned by Mr. Searls.

It will make a difference of 50 cents a thousand of the cost of brick in place. Instead of it being say $30 a thousand in place, it will be something like $29.50. It is .36 of a cu. yd. to the running foot in the Bald Hill Tunnel; 1,000 brick makes 2 cu. yds., so that would be, you might say, .2 of a thousand brick. 50 cents on .2 of a thousand brick would amount to 10 cents a foot on the cost of the tunnel. It really is an immaterial figure. It would amount to about 10 cents a foot on the cost of Bald Hill Tunnel.

Mr. Hazen: To clear up the matter at once, there is a little different point of view I had on that. I have always found that building brick, such as we use for ordinary brick houses, were not suitable
6890 for this kind of work; brick for any hydraulic construction, where it is under water, has to be selected, and without knowing what the conditions are, I would assume that some extra expense would be involved in that; perhaps not over $1 a thousand above the going price of ordinary brick as quoted.

Questioned by Master.

Mr. Lippincott: That is the price of common brick. I am willing to admit that I know very little about brick work. I have never put a yard of brick in a tunnel. I have never put a brick anywhere, except in a wall in a park. We use concrete. These brick that I am quoting are what are called common brick, the cheapest brick in the market. If you have to use a better variety of brick, it would make a difference in these figures.

Questioned by Mr. Searls.

Mr. Hazen: I do not know of any quotations for the kind of brick of which I speak. I know that in the years gone by, when we used to use brick, we had a great deal of trouble in getting brick to come up to the requisite quality, and that it meant selection, and it meant extra cost; just what it was, I could not tell now, and I certainly have not any figures relating to this market. It is not what is called pressed brick.

Mr. Metcalf: In our sewer work we have a characterization there different from the ordinary brick. The ordinary brick is the run of the kiln. Sometimes the blackheads, which are next to the flame, and which have been fused, are omitted; in the run of the kiln, you have a variation from very hard burned to under-burned brick. In the sewer work we designate it as hard-burned brick. Those are
6891 selected, and usually cost from 50 cents to $1 a thousand more than the others. Of course, I do not know what your practice is here.

Mr. Lippincott: I would like to give the figures I obtained from the McNear Brick Co., San Francisco prices. They are as follows:

1909	$7.00
1910	6.50 to $7.00
1911	6.50
1912	7.25 to 7.50
1913	7.25 to 7.50
1914	6.25 to 6.50
1915	7.50 to 9.00
1916	9.00

What we did was to go down to the brick company and go over their bills. We found the actual prices for which they sold the brick. It was between those figures named for common brick.

Questioned by Mr. Searls.

The brick man told me that San Francisco was a market in which all the brickyards around the country placed their surplus stock; that nearly all of them tried to have their local market where they got prices more agreeable to them; that the surplus came to San Francisco, and that the price of brick in San Francisco usually was lower than anywhere else around the surrounding country.

(The above was stricken out, as it was just information that the witness had.)

CROSS EXAMINATION BY MR. SEARLS. 6892

The source for my price on cement I endeavored to go into quite extensively on my direct examination. My price on cement is a sort of a composite figure, based on a good many years experience in buying cement in different places in California. The price of $2.10 was the ordinary going price of cement up and down this coast between Los Angeles, or San Diego, and San Francisco. It is not based on any particular quotation. I was governed a good deal by the price we were paying for cement at Santa Barbara within the last year or so. In the year 1913, I think, we bought cement for $2.10 a barrel in Santa Barbara in quantities of 4,000 or 5,000 barrels. In reproducing the Spring Valley structures I did not try to reason it out in my mind whether the cement for those structures would be bought under one contract or several contracts. I think the company is now buying cement in very considerable quantities for the Calaveras Dam, and are paying as much as $2.10 a barrel for it. They purchased 22,000 barrels from October, 1913, to November, 1914, for delivery 6893
at Milpitas, $2.13 net.

I don't know that you could say that the Calaveras Dam contract would be insignificant as compared with the Crystal Springs Dam. As I remember it, there are 150,000 yards in the Crystal Springs Dam, and at a barrel a yard, that would take 150,000 barrels. This is a 22,000-barrel purchase.

The E. B. & A. L. Stone Co. gave me the price on sand, and also I inquired at Niles. I also got figures from the purchasing agent

of the Spring Valley. I didn't call up the people at Niles myself. One of the other men did it, but I did go around to the E. B. & A. L. Stone Co. personally and made inquiries. The information obtained at Niles was the same that I got from the Stone people. I inquired from the Stone people as to the price of sand at San Mateo, as I
6894 remember it. The cost of Coyote Creek gravels, screen gravel, for last year at San Mateo was 85 cents a ton. Sand is also 85 cents a ton. At Redwood the price is 80 cents a ton for sand and gravel. One cu. yd. of screen gravel weighs 2,800 lbs., and 1 cu. yd. of screened sand weighs 3,000 lbs.—this is for wet sand. That was my information from Stone, and is practically the same figure that Mr. Dockweiler used. At 85 cents a ton, it means about $1.10 a yard.

I did not consider that the sand taken from the adjacent dunes might be suitable for the concrete mixing on the Lake Merced Tunnel. I don't know that that sand was used in the original construction of the tunnel.

Mr. Searls: That is the information I have from one of the foremen on the Lake Merced job, that they took it from the dunes there where they did not have to wash it. Water was hauled up from the lake in barrels to do the mixing.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Lippincott: I took the prices on lumber from the prices we paid for lumber on the aqueduct, delivered to Wilmington and San Pedro at the wharf. I left the aqueduct on August 1, 1913.
6895 I did not figure on paying the retail prices for lumber. We bought in enormous quantities. It is a very interesting thing the way they fix the price on lumber; they have what they call a base price; that is for a stick of certain dimensions; then everything goes up from that. We would get a price bid on this base price of lumber for all we wanted for a period of say six months. We bought practically by the shipload from the lumber companies in Los Angeles, and I think most of them had mills up in the lumber country. The price was quoted us at the wharf in San Pedro and Wilmington, and it was f. o. b. cars at Wilmington and San Pedro, whichever it was.

I did make some figures on what the price would be if we bought by the cargo load and took the lumber off the ship's tackle, but I have forgotten what they are. I think there is a differential. The
6896 harbor facilities at San Pedro are such that you could run cars directly under the ship's tackle and load from there.

Questioned by Mr. Greene.

I don't know that that is the way we did load; we got the lumber, as I remember it, f. o. b. cars San Pedro and Wilmington.

Mr. Searls: Our information is that it makes a difference of from $2 to $3 in price if we take it that way; Mr. Greene's information is $2, and mine is $3.

Mr. Lippincott: Who pays for the dockage and for the wharfage?

Mr. Searls: The seller pays the charges of docking the ship, and the wharfage charge.

Mr. Greene: I think that possibly explains the different price 6897
that you got, \$3, as against the \$2 or \$2.50 price that I got. That might be responsible for a portion of it.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Lippincott: I did not endeavor to get any local figures on hauling costs. I have had to do hauling of various kinds in a great many different places. I have not done any hauling in this section of the country, and do not know what prices are being charged here for motor truck hauling. I did not assume the use of motor trucks. It seems to me I saw a hauling contract on Hetch-Hetchy work for San Francisco the other day, and I figured it out at somewhere about 35 cents a ton-mile. I am not certain about that 35 cents, and I may be wrong. There is one very bad haul in the Tuolumne haul, Priest Hill; but this is mountainous hauling on 6898
this peninsula.

Page 16, Exhibit 133, where I take my direct cost of \$12 per 6899
foot for excavation; that was a matter of personal judgment. I thought I had made quite extended analysis into these tunnels that were used as illustrations, but after using them, I simply expressed my judgment as to the cost per foot of driving these tunnels in the Peninsula system at \$12. I do not mean that I used the aqueduct tunnels as an illustration, but I used all my experience that I had. The tunnels I refer to were the aqueduct tunnels, and the Santa Barbara Tunnel, particularly. On page 7 of Exhibit 133, you will find a column marked "Excavation" that might throw some light on the matter. The \$12 a foot which I used was a matter of judgment as to the cost of excavating the Peninsula tunnels, for direct charges.

I want to make a correction in my statement as to labor charges 6900
on these two tunnels, the hand-driven tunnel and the other one. I stated the other day, I think, that the labor charge for driving Tunnel No. 9, which was the machine-driven tunnel, was \$9.15 a foot. I compared it with the hand-driven Tunnel No. 6. I found in looking over this this morning a little more closely that there is this condition, that the labor charge for excavation for Tunnel No. 9 was \$9.15 a foot as stated previously; that the labor charge a foot for timbered section of that tunnel was 93 cents a foot which I had not previously entered in; that made \$10.08 a foot for labor for this timbered, machine-driven tunnel. That is the figure that should be compared with the \$13.58 a foot, which I think I gave for the hand-driven Tunnel No. 6.

As to the size of a crew on a tunnel like the Bald Hill Tunnel: The cost per foot we have, say, $10 for the machine-driven tunnel; 5.8 feet to the shift would mean a labor charge of $58 to the shift. I think that that labor will average nearly $3 per day. That would be 19 men, which would include all the men who are engaged inside and outside the tunnel. The miners, the muckers, the men driving the motor, the blacksmith, the timbermen working inside the tunnel, and the carpenters on the outside who are framing the tunnel timbers. It depends on how rapidly you are driving the tunnel
6901 whether or not the timbermen do that. If you were going 5.8 feet to the shift, I think you would probably have a carpenter working in the line. That would also carry the proportionate part of the compressor house crew, a construction clerk, and the watchman whom you always have to have to keep the camp straight and clean, and you should have two or three laborers working around the tunnel on all sorts of odd jobs.

Questioned by Mr. Greene.

The foreman comes in under that, too. I noticed that Mr. Dockweiler, in speaking of the hand-driven tunnel, had a crew of about nine men. I think he omitted the driver of the car. Of course, we don't have a compressor man. It is quite common to have a man to keep the tram in condition, and there is also a camp watchman.

CROSS EXAMINATION BY MR. SEARLS.

I think it would be a proper thing to keep an extra man to keep the tram in shape in a half-mile tunnel. I think you would have a construction clerk, a man who would keep the time of the laborers working on the tunnel, who would take in the bills for materials, and issue supplies and things of that kind. Then you would have the laborers, and possibly a powder man, or a portion of the time of a powder man. I would have one construction clerk to about three or four tunnels, traveling around taking the men's time, and that might or might not be a direct labor charge against one tunnel,
6902 depending on local conditions.

Roughly speaking, we paid in this tunnel $3 a day for miners in a dry tunnel, and if the tunnel were wet, $3.50; about $2.75 for muckers in a dry tunnel, and $3 if it were wet. A blacksmith you would pay $4 a day. On common labor in a tunnel, working underground you would pay from $2.50 to $2.75. Motorman $75 or $80 a month. I didn't give $1 a foot as a fact as my charge for small tools, blacksmith tools, etc.; I expressed it as a matter of judgment. It is a great big bill. If Mr. Lawrence expressed 25 cents a foot as a fact, I would, of course, accept it; if he gave it as an estimate, I would think my judgment just as good as his, and I would rather be inclined to take my judgment in the matter. It is an exceedingly difficult thing to keep track of the cost per foot of small tools. We

found it impossible to do that, and segregated the charge to each particular job. We had to let the whole thing go until the work was finished, and then distribute it broadcast over the entire enterprise.

RE-DIRECT EXAMINATION BY MR. GREENE. 6904

As to why I did not use compressed air in my construction of the Merced Tunnel: I don't know that I could make an exact estimate on the cost of installing and operating a compressed air plant, and I could use the other thing, and it seemed to me the situation was well adapted for this pumping method, and it was one that I had practiced. I did not select it because it was the cheapest method, but as the one that I was familiar with.

This lean concrete that I propose to install was a mix of 1 of cement, 6 of sand, and 12 of broken stone; then it was reduced in price still further by adding a cu. yd. of large sized rock to the broken stone, making a total cost per yard, including mixing and placing, of $4. It seems to me that that is about as reasonable a thing to do as to try and ram in a clay in those corners, and then ram stone into the clay. I don't believe it would be a material difference in cost.

The kind of ground that you can use an auger in must have enough cementing material in it to stand up, so that it won't run on the one hand, and which will carve or cut or trim with a pick on the other hand. I don't believe you can use an auger in material which you could not pick. You might be able to, but I don't believe you could do it efficiently and economically. The kind of material in which you would use an auger is found in a good many places in the State. It is sometimes referred to as a soft sandstone, 6905
or an indurated sand. It is one of the later geological formations that has not been consolidated into a rock. It is a material that will carve, or that you can cut with a tool other than a drill. I don't know how to describe it much more than that.

Questioned by Master.

The auger that I speak of is not like a post-hole auger. The thing I have been familiar with is like this: Take a flat piece of steel about two inches wide and about ⅛ inch thick; it is heated and then twisted into an auger shape. Then the bottoms of it are split and turned up a little bit so as to have a cutting edge. You bore a hole that is perhaps 1½ or 2 inches in diameter that way, by hand. You put a handle on it and cut it. Then you use a little powder to scatter the ground in the center of the section, and then you pick it out with a pick. If it is done skillfully you don't have to timber it. I did not imply that that system was followed in the Spring Valley tunnels. I distinctly said that that method could not be used in any tunnels I have seen. The reproduction cost prices

which I have put on these various tunnels do not include any allowance for profit, but is the cost of doing the work on the day-labor basis.

My item of roads, as I have used it, I did not intend to include construction costs alone. It was both the building and maintenance and operation of the road. These figures that I have given for in-
6906 direct cost are given for the purpose of illustration. I do not mean to say that you will have these exact percentages in this tunnel, or that you won't have other things that may happen. It is just an indirect charge which is the result of my experience in driving tunnels that should be allowed for.

Questioned by Mr. Searls.

It is not my contention that the total is the only variance. I think I gave examples of quite a wide range of those indirect costs on different tunnels.

RE-DIRECT EXAMINATION BY MR. GREENE.

The maintenance of roads which were used for these purposes would involve the expenditure of an amount of some size.

In regard to the number of cars which I would assume to be used in a half-mile tunnel; there is this much to be said about the use of those nine cars in the heading: After you fired a round I think you would find everybody would get into the mucking game, or be employed in filling these cars, and getting rid of the muck pile as quickly as possible. After that, perhaps, the work would not be carried on as quickly as on such an occasion.

Questioned by Mr. Searls.

The miners, I think, might help do the mucking. They don't like to, but I think they might help.

RE-DIRECT EXAMINATION BY MR. GREENE.

I did not intend, in the use of my direct charge as a whole, to
6907 give the impression that the same charges would be included in my 40%, or that the same pro-rata would apply to any two pieces of work. My idea was that tunnels were a hazardous thing to drive, and if it were not one thing that happened it would be something else. I have here a set of photographs of these tunnels; on page 2 there is a photograph showing Lock Creek Tunnel No. 2, which, I understand to be the Stone Dam Tunnel No. 2. It is marked here "Very hard rock, timbering not required". I call particular attention to the overbreakage. Mr. Dillman said that the tunnel, if done as he has described, is broken to the seams, and leaves large cavities that will have to be filled. I think, probably, in concreting a tunnel you would fill those cavities with the concrete you are regularly using in lining the tunnel. That usually amounts to about 50% in excess of the theoretical concrete yardage.

On the next page is shown a photograph of Stone Dam No. 2, which shows the effect of swelling ground on the timbering. This is called the Sawyer Tunnel, which I understand to be the Davis Tunnel. I wish to call attention to two things in this photograph: 6908
In the first place, it may be noted how the timbers have been driven on the side. That means that the ground is heavy. The roof timbers had to be driven ahead by bridge work, it is what I call spiling, and Mr. Dockweiler calls poling.

I call particular attention to the way in which some of these cap posts or cap sets have been broken, indicating swelling ground. There is an indication that the driving is carried on under a difficult condition. About the first post on the left also shows the effect of the heavy ground. Now, the thing that will have to be done there is that those timbers will have to be taken out and thrown away and new timbers put in their places, correct and true to the line. That is rather nasty and difficult work.

Locks Creek Tunnel No. 2, which I understand is Stone Dam No. 2; that shows a section in heavy ground, because what we call the bridging or spiling work, showing that the timbers had to be driven ahead of the excavated face in order to prevent the running or heavy ground dropping down into the tunnel, before the timber sets could be fixed up, are shown here.

No. 58-D, the Davis Tunnel, shows the tunnel is in good form; concrete has been placed in the background of the picture and on the sides, and not placed in the foreground. That tunnel is in good condition.

No. 58-C, Merced Tunnel; my estimate was based on a 9-inch ring of brick, or 9 inches of concrete, and it will be seen by this picture that there are three courses of brick work, and so at least in this place that lining was 12 inches thick. It also shows that practically the backfilling of the tunnel was done with brick. It 6909
also shows the bridge work or spiling being driven, which means that the ground is heavy, running ground, and the excavation had to be protected by driving these spiles or poles ahead of the excavated space.

No. 504-D is an ordinary tunnel seam.

41-B and 42-B are views of the Merced Tunnel. They show the great difficulty being encountered in driving the tunnel through wet sand. The spiling is being driven ahead. The weight on the timbers is such that the center support had to be put in in order to prevent crushing. It shows that they were in serious trouble at that place. I consider driving tunnel in wet sand as about the most difficult kind of work you can experience.

A book of photographs of tunnels introduced and marked "Plaintiff's Exhibit 143". 6910

RE-CROSS EXAMINATION BY MR. SEARLS.

I have not any costs on the cost of placing the backfill. The only place where we made a separate mixture of concrete for filling up the back holes was on the Elizabeth Tunnel. On most of our tunnels we just took the straight concrete, the regular run of concrete, and filled up all the cavities. If we had one of these big holes in the roof that I talked about, I would not fill that full of concrete. I know that in the Elizabeth Tunnel we filled up right to the roof, and I don't remember of any other method we did than that. At Santa Barbara, however, where we had these bad caves, we did block up with timbers, and fill up the crown of the tunnel with large stones. On the Elizabeth Tunnel a concrete mixture was used all the way through for backfill. That was our ordinary method of procedure on the aqueduct.

6911 The practice which we followed on the aqueduct, as far as I can now remember it, in the tunnels that were not timbered, was to completely fill the tunnel with concrete back into these holes. In cases where the tunnel was timbered and lined, it was my recollection that we would pile broken stone, or the large stone that we got from the face of the tunnel, on top of the lagging, and on the sides of the lagging. That would be an impossible method of proceeding in constructing tunnels such as these, where you are digging in rock and timbering your tunnels, but I think it is also fair to say that I did not figure on any excess yardage in concrete at all in these tunnels. I did figure on a considerable amount of concrete in my backfill, but I did not figure on the placing of any material behind the lagging, or on top of the lagging in the tunnel.

Speaking of the cars: It is a fact that when you shoot a round of holes in a tunnel that consists of blocky rock, the face of the tunnel is pretty well filled with debris after the shot, and it is not possible, as a rule, in these smaller tunnels particularly, to promptly set up the drills again. If the miners do not help in the mucking, they would simply have to wait until quite a little of that mucking is gotten out of the road, and under those conditions I think probably the miners would help. To be perfectly frank with you, Mr. Searls, in your hand-driven tunnels, such as you were talking about, I think perhaps my nine cars were too many, and I might throw off a couple of cars on that, but for the machine-driven work I would not want to take off a car.

Hazen

Witness: Allen Hazen for Plaintiff, recalled for cross examination.

6912 Questioned by Master.

Where there is an overbreakage in very hard rock, and the tunnel is afterwards filled with cement or brick, it is customary to

fill up those voids, except where there are very large breaks overhead. My experience coincides exactly with Mr. Lippincott's. If the overbreakage is not too great, they put in the ordinary concrete in preference to running a special mix. If there is an occasional hole, it is customary to put in plums, as many plums as can be put in that space. If there is a considerable space, outside of the regular concrete section, it is customary to mix concrete with about half the usual amount of cement to fill that. I have seen breaks going up 40 or 50 feet; of course it is not feasible to fill that up with concrete. In my experience a break like that has been closed by putting in a layer of concrete perhaps three feet thick. That would depend on the size of the tunnel, but with a small tunnel that is done, making it strong enough so there would be no probability of its being seriously damaged by any rock falling on it in the future. Of course, if it is a very hard rock, and it is not likely to break, there is not the necessity of lining that there would be in other tunnels.

CROSS EXAMINATION BY MR. SEARLS. 6913

My personal experience with tunnels is limited to the Little River Tunnel. I have driven a few short tunnels besides that, which are not comparable with the Spring Valley tunnels. I drove a tunnel under the railroad yards at Albany some years ago, running diagonally across the main line of the New York Central, with a good many tracks, at a depth of about 30 or 35 feet, through hard clay. I drove a tunnel in Watertown, N. Y., through some limestone, under some power structures, a very bothersome piece of work, and costing, as the Albany Tunnel did, a great deal more per foot than anything we are talking about in this case. I don't think the data of those would help us in this case. The Little River Tunnel is the only one comparable with this Spring Valley work that has been driven under my direct supervision.

I have made a study of all the data relating to small line tunnels that I could get, but that is rather meagre; there do not seem to be many such tunnels on the Pacific Coast.

I think there is a very substantial difference, as far as the cost of excavating goes, between a tunnel which is to be lined, and which is not to be lined, where it is necessary that the bore of the tunnel be comparatively smooth anyway. My point of view is that to build 6914
a line tunnel five or six feet in diameter you will get figures representing good, careful work, ranging all the way from 1/3 for drifting, and 2/3 for lining, to 2/3 for drifting and 1/3 for lining; in other words, you can drift them carefully and get a tunnel that is easily and cheaply lined, or you can drift more cheaply, and get a drift that it costs a great deal more to line, and the end result is the same in either case. If it is not to be lined, then the cheaper drifting will naturally be selected, so I do not look on the cost of drifting

tunnels that are not to be lined as helpful at all in discussing this question, except in the most general way.

The price per yard does not mean very much in itself, because the real question is as to the place that has to be filled. It ordinarily costs a great deal more per yard to place concrete in tunnel lining than it does in corresponding structures out in the open; that is largely because of the forms that have to be used in the tunnel lines; the forms in current work are of steel, they are collapsible, and of certain length—perhaps a couple of hundred feet—are put up, and the concrete is placed back of that. I don't mean 200 feet all at
6915 once, but I mean five feet are put up, and the concrete put back of that, and then another five feet, and so on, until a couple of hundrd feet of forms are up. At the end of that time you commence to take the forms down at the back end of your 200 feet, and bring them forward inside the forms that are there, and set them up in front again, and so proceeds the process. The cost of the forms, and getting them collapsible, and so they will go through themselves, means quite a heavy expense; that expense is quite a part of the cost. The cost of putting in more concrete to fill up a space outside, for instance, does not affect the cost of the frames. It is simply so much more material to go in. While the cost of concrete as a whole may be $15 or $20 a yard, it only costs you perhaps $10 a yard for the surplus material that goes into the hole. I don't think the cost per yard of concrete in tunnels can be discussed very well as a separate item.

The figure of $35 per foot for drifting, timbering, and lining excavation, of general overhead, is for a 6-foot tunnel, through rock like the rock on the Peninsula and Sunol; that is based on my judgment, supported by the data that I have told you about, and all the experience that I have had with tunnels. Those figures as to the cost of the Spring Valley records, were all from Mr. Sharon. They are old figures, and we don't know very much about them.

6916 As to the Stone Dam Aqueduct Tunnel No. 2, Mr. Lawrence has the payrolls, and I used those payrolls; the rest of it is an estimate. For the Davis Tunnel, I put in a sheet of more details yesterday, which came from Mr. Sharon. I think that was an official report from the company to the City of San Francisco at one time. Sunol No. 2, which was driven by the Western Pacific, was driven under the supervision of Mr. Lawrence, and he had the record of cost, and I got that from him. I have attempted to have that checked from the Western Pacific record, but I have not found anything as yet. It seems that on the Sunol Tunnel No. 2 the cost of drifting and timbering was done at a price of $11.06. They drifted this tunnel too large, because they could drift it cheaper that way. When they got it drifted, they found that to line it the same size as the other Sunol tunnels, the overbreak was too great; it was going to take

an extravagant amount of concrete, and they increased the section of tunnel considerably above what was required, and reduced the amount of concrete that was required. That is a surmise on my part, and I have no way of checking it. I cannot imagine any other 6917
reason why this should have been larger than the other tunnels of the system.

I have not attempted to segregate the cost of segregating and drifting from my costs of lining. I should say that according to the care with which the work, in my judgment, in a general way the drifting would cost anywhere from 1/3 to 2/3 of the whole amount, and the lining would cost the rest, the lining costing more, and the drifting costing less. It costs a great deal more to drift a tunnel accurately so that it can be cheaply lined, than it does to simply go ahead and blow it through. I think that the cost of lining Sunol No. 2 is a normal figure. I do not think that the cost of lining those tunnels would be the same. Some might be lined for less than this, and some for more. I see nothing particularly abnormal in this estimate. The section of this tunnel was 6.2 feet. That is my equivalent. The section of the drift was 9 by 9, and I do not think the cost of lining this tunnel was excessive. If they had drifted this more carefully, they could have lined it more cheaply. I am inclined to 6918
think that the tunnels driven by Mr. Schussler were more carefully drifted, and they probably could be lined more cheaply. If they had been driven more carefully, the drifting would have cost more, but the finished cost might not have been any greater.

I believe this tunnel was built in 1908. The $35 in my estimate, is the estimate of the normal cost of driving a tunnel, but in this particular tunnel a little of this was open cut, and adjusting for that, my estimate for this tunnel on a normal basis is $31 per foot. That is $3.12 above this reputed cost. This reputed cost is not known to a certainty to be the full cost. Mr. Lawrence thought that he had all the items, but I do not think that can be counted on as a certainty. The inventory does not show that there was an open cut in this Sunol No. 2, but I estimated it as having some. I determined that by inspection, by walking over it. The cut was not 6919
so great there as in the others, but there was a little. I figured 790 feet of tunnel, and 66 feet of open cut, total 856 feet, as shown on page 1 of my exhibit, as being the length of that tunnel.

Mr. Dillman: I figured it 856 lineal feet of tunnel, just as the inventory gives it. I went over it, but I did not correct this inventory.

Mr. Hazen: The 66 feet is my own estimate. I may be somewhat in error as to that, but that is my judgment in looking at it.

CROSS EXAMINATION BY MR. SEARLS.

Referring to the early tunnels of the Spring Valley system: I cannot tell you from what source Mr. Sharon got his figures. I

asked him to get all the information he could about the cost of those
6920 early tunnels, and he gave me these figures. Mr. Schussler gave me some figures which were entirely consistent with these as far as they went. I can't tell you whether they were part of the company's records, but I suppose they were. Mr. Sharon did not furnish me with any segregation of those costs. Mr. Schussler did in one case. I had a conversation with Mr. Sharon as to the Stone Dam No. 1, but it was quite a while ago, and I don't dare trust myself to tell
6921 you about it now.

Page 3, Exhibit 139; I cannot substantiate that the labor cost now is about twice what it was when the tunnels were driven. That is my general impression. I made no use of that ratio in any way. It is simply a statement of my belief that the labor cost is probably double what it was at that time. I did not try to resolve these figures into present day cost on the basis of the original cost. I used these original costs simply as throwing some light on the difficulties that were encountered. If they cost $100 a foot, that would have indicated that there had been some unusual difficulty that ran their costs up; if, on the other hand, they cost $10 a foot, that would have indicated exceedingly easy conditions of tunneling, or something that we had not taken into account. Running as they did, they seemed to me to be consistent with the estimate I was making.

6922 My idea of it in very general terms, my estimate is something like 30% or possibly 40% more than the original cost. The price of labor, I think, has doubled; that is not exact, and may be somewhat in error; at any rate it has gone up tremendously, while, on the other hand, the methods of tunneling have been improved, so that the cost of tunneling increasing with the labor at that ratio I do not think would be a fair guide to use. I am not sure that the elements of lining a tunnel have gone down immensely. Cement is cheaper, but the expense of those items, the sand and the stone, is pretty largely a matter of haul, and I expect that the hauling was cheaper in those days as well as was the labor. It may be that they are some cheaper, but I do not believe the difference is as wide as the change in labor.

The figures for the Davis Tunnel were obtained from Mr. Sharon. I have placed with my testimony a statement showing the sheets I have obtained from Mr. Sharon setting forth those figures, and
6923 which I summarize in this statement.

The Master: There is a difference of 4 cents there between the figures in your exhibit, and the sheet which was bound in with the testimony.

Mr. Hazen: I make these divisions habitually with a slide rule, and they are approximate; oftentimes the young men, in checking over my figures, carry them out further and correct them.

CROSS EXAMINATION BY MR. SEARLS.

I went over all these figures with Mr. Lawrence a year and a half ago, before I made this estimate, and I used them as far as I thought they were suitable. Mr. Lawrence's exhibit, and what he has testified to since, I have not followed. I just looked at his exhibit rapidly within the last few days. There was a little discrepancy between Mr. Lawrence's record and the one I had from Mr. Sharon; 7 cents discrepancy, and I did not attempt to follow that further. I have not figured out the estimated cost of lining this tunnel per cubic yard, using the 1913 prices. I cannot tell you the number of cubic yards per foot, as I have not figured it that way. My figure of $18.39 was the original cost, and I have added 45% just for the labor, and with a deduction for the decreased cost of cement. I didn't 6924
have Mr. Lawrence's reproduction cost on the lining; I did my own calculation on his original figures as far as I used them. Mr. Lawrence and his father handled the payrolls, and they knew what the payrolls were; I think there is no question but what the data Lawrence has at Millbrae with regard to payrolls is as correct as it could possibly be got. When it came to the materials, I was satisfied from the investigation I made down there that the materials were often sent in, and the bills did not go through their hands, and that as far as statements for materials went into the Lawrence record, they could not be depended on to represent the whole cost. That is my judgment and my conclusion. I do not trust Mr. Lawrence's records on materials; on payrolls I think they are absolutely sound.

Mr. Searls: Q. If you take the total of Mr. Lawrence's figures there on T-10, you find he has used 11,812 feet; on page T-8 6926
you find originally drifted 12,312.7 lineal feet; then after that it says "including 500 feet open cut between the two tunnels", so that his 11,812 is net; now, taking his original cost figures alone, I find from his exhibit that he has figured the cost of drifting and timbering at $8.04 per lineal foot, and of lining at $6.63, making a total of $14.67 per lineal foot in 1899 and 1900. If his exhibit shows that, it does not seem to check your estimated cost there, does it?

A. There is no reason why it should check; it is for another piece of work, done at another time, and done on an entirely different wage schedule. There was substantially a 90% increase in wages between the two periods under discussion.

Mr. Hazen: I don't think Mr. Lawrence has the complete cost of that work. I spent some time a year and a half ago with Mr. 6927
Lawrence trying to reconstruct an estimate from that Sunol data, and it was so unsatisfactory to me, making the best use of all the data that I could, that I did not consider it; the record was too fragmentary and too incomplete. I think his payroll was correct, but I don't feel sure that the quantities of timber he had were correct. I

thought they were too low; the explosive was altogether too low, and the allowance for the auxiliary expenses or equipment charges was wholly inadequate. Mr. Lawrence or his father did not pay those bills; they simply represent his notes. I don't know whether they had to approve them before they were paid or not, but they had no complete record of them. I am certain that they did not have a complete record of all the equipment material that came into their charge, because, as I stated yesterday, I found one case of a concrete job where no cement came into the record, and I know they could not have built it without cement.

The open cut and the tunnel work were done at the same time, and the segregation of those costs is very uncertain, in my judgment. I think that in addition to the 500 feet of open cut there were some
6928 1700 feet of open cut built also at the same time. It is not my idea that these figures include some of the material that went into that 1700 feet, but the labor was on the same payroll, and the materials came on the same bills, and the separation of the payroll and the bills, by Lawrence, into parts, one tunnel and one open cut work, in my judgment is uncertain. I can't imagine that those tunnels could have been drifted with the amount of explosives that Mr. Lawrence has on his record. He allows about 40 cents per foot.

Mr. Dillman: 40 cents—that doesn't sound out of the way.

Mr. Dockweiler: I have only allowed about 10 cents for these Peninsula tunnels; my allowance on the Sunol is about 40 cents a foot for powder. They had some hard spots but they didn't use much powder.

6929 Mr. Ellis: I made some figures awhile ago, checking up some tunnel work that was done through the same formation when they ran the drift for the Richmond Highway Tunnel. It was carried through a series of three drifts first, which were, perhaps, just a trifle larger than the Sunol Aqueduct. The amount of explosives they were using there ran about 40 or 45 cents a foot. They were using from two to a little over to the yard, and were drifting with nine holes all through there.

The face in the rough was about 9 by 9. It was the Highway Tunnel. It was carried through with the ordinary system, 2 bottom hole drifts, and a crown drift, and then the wings, and then the core taken out with the shovel. The drifting was through similar material, as near as I could see at the time, to the Sunol Tunnel; it is this blocky shale, with the exception that in the Richmond Tunnel they had about 25% of the drifting through a sort of a trap rock, this large blue rock, which did not materially affect the expense one way or the other. It was about as easy to handle that as it was the shale.

They used 1⅛ inch giant powder. I didn't notice the loading of the holes, but I presume they were loading with 1⅛ inch; I didn't

notice the length of the stick. It depends on the size of the stick. We used to get 50 lb. boxes of powder, and in the old way of making it, it used to run 130 to the box; now they make their sticks so they weigh more to the stick, the exact weight I could not say. 6930

Mr. Lippincott: In those tunnels I referred to near Little Lake, they were using 11 lbs. of powder to the foot on the Little Lake Tunnel.

Mr. Ellis: Of course this shale is an entirely different formation from the Little Rock formation, so far as shooting goes; this is soft rock, heavy timbered ground. The expense here is not drifting; it is timbering and catching up those delays. On some of that class of work they made, I think, as high as 7 and 8 feet to the shift. The average over the whole run was under four feet to the shift, due to delays on the timbering stuff. The explosive, though, was small. You can shoot that face with nine holes.

Mr. Hazen: Mr. Lawrence's notes show 21,700 lbs. of explosive, which is equal to 1.9 lbs. per foot. I certainly never heard of tunnels being driven anywhere with so small an amount of explosive. My experience has been in hard rock. Looking at page T-9, it looks as if Mr. Lawrence had found some more powder between the time I went over it with him and the time this was prepared. It is 36 cents a foot, even at that. I had not studied this, and didn't notice the discrepancy. 6931
When he gave me this list amounting to 1.9 lbs. per foot, I was so certain that it was incomplete that I disregarded it.

CROSS EXAMINATION BY MR. SEARLS.

Lake Merced Tunnel: I have estimated $36 per lineal foot on that, but I do not think that figure is at all comparable to the case, and it cannot be estimated in the same way. Driving tunnels through wet sand is likely to be very difficult and expensive. I do not know any way that it can be closely estimated. I did not study particularly the number of wells which were originally driven to handle the water 6932
on that tunnel. I think there was a drain underneath the tunnel to carry off water, and it would be my thought that that carried off more water than was taken out of the wells. I refer to the pipes that were laid in the tunnel, and that were not taken care of as a separate item in my estimate. The $35 per foot covers everything. I have looked up the history of that, and the record shows that at the beginning of operations the ground water level averaged about the level of the top of the tunnel. It was higher at one end and lower at the other; they started to drift at both ends, and at the ocean end they drove something like 800 feet, and then ran into ground so difficult that they could not hold it, and they stopped, and that work remained, apparently, for a long time. From the other end they made an average of about six feet per day, making about 1,750 feet in a year, and then in fifteen months or so they came to within about 100 feet of the other

heading where they struck trouble, and the whole top seems to have caved in. They drove shafts around in other directions, and had a good deal of trouble before they got through that bad 100 feet.

I think you would have to lower the ground water level by some method below the base of your tunnel excavation to make much progress. Putting a well down 50 feet would be one way of doing that, and a very good way. Whether it would be the best way or not, I do
6933 not know.

Mr. Lippincott: I did not suggest putting shafts down every 50 feet. It was a driven cased well every 50 feet; not an excavated shaft.

Mr. Metcalf: It adds about 20% to his price. It was about 1/5.

Mr. Hazen: I did not find any data as to the original cost of the Merced Tunnel. I have no data showing the cost of free air tunnels in the East which in dimensions are anywhere near the ones involved here.

NINETY-SIXTH HEARING. FEBRUARY 14, 1916.

Witnesses: Allen Hazen for Plaintiff.
J. B. Lippincott for Plaintiff.
J. H. Dockweiler for Defendants.
Marius J. Kast for Defendants.

Witness: Allen Hazen for Plaintiff.

6934-6935 The following letter, which was addressed to Mr. Olney, by Mr. Wyche, chief engineer of the Western Pacific, was read by Witness Allen Hazen:

"Western Pacific Railway,
"San Francisco, Calif.,
"Feb. 11, 1916.

"T. J. Wyche, Chief Engineer,

"Mr. Warren Olney, Jr.,
"Receiver, Western Pacific Railway,
"San Francisco, California.

"Dear Sir:

"Herewith please find attached, cost of concrete tunnel built by "the Western Pacific for the Spring Valley Water Co., location, Mile "Post 33½, north of Western Pacific Tunnel No. 2, also sketch show-"ing the neat cross-section of same. Excavation and timber lining "was done under contract, E. B. & A. L. Stone Co., and the labor for "concrete done for the Spring Valley Water Co., which the Western "Pacific paid by voucher, the material being furnished by the West-"ern Pacific.

"On account of overhead crossing Spring Valley Water Co.'s "flume at our tunnel, we reinforced 308 feet of our tunnel with con- "crete lining, at a cost to the Western Pacific of $3,207.33. This has "no bearing on the water tunnel, but simply a matter for your in- "formation. 6936

"Yours very truly,

"(Signed) T. J. Wyche."

The statement attached is as follows:

"Location......M. P. 33½, north of Western Pa- "cific Tunnel No. 2.

"786 feet......length of tunnel.

"Size, 6 x 8 feet, concreted entire length.

"Excavation, 786 lin. ft., at $15 per ft. ..	$11,790.00
"Timber lining, 49,844 ft. B. M........	1,993.76
"Concrete, 988 cu. yds................	15,850.78
"Total cost	$29,634.54"

This was accompanied by a drawing showing the neat section, which corresponded substantially with the section already in evidence.

Questioned by Mr. Greene.

Mr. Hazen: I made a comparison in this way:

Mr. Lawrence's estimate of the cost, made immediately after the work was done, and put in writing by him at that time, and which was made up of his own payroll, and his estimate of the materials furnished, and his information on the cost of driving the tunnel was $23,437.87. That was the figure which I used for the basis of the calculation which I made, but with the reservation that I was not satisfied that that was the whole cost. My estimate for this stretch was $26,536, that not being based on Mr. Lawrence's record alone, but made uniform with my other estimates for tunnels in the system. The present statement shows an actual cost of $29,634.55, being approximately $3100 above my estimate for this work. 6937

Reckoning the whole cost on the tunnel section alone, the cost per lineal foot is about $37.80. I wrote that on the original, and that is why the original is not shown here. Reckoning it on the whole section, open end tunnels, it was $34.80. The cost of the tunnel would lie between those, perhaps approximately $36 per foot. My figure per lineal foot was $31 on the whole section.

Mr. Lippincott: Mine was $31.88.

Mr. Hazen: I figured $33 for the tunnel, and the smaller figure, I think, $14, on the rest of it.

Questioned by Master.

Mr. Hazen: I figured on 790 feet of tunnel, so that my length differed from that which is shown in the report of Mr. Wyche by 4

feet. The balance is cut and cover work, open cut, and is included
6938 in my sum of $26,536. I think the cut and cover work was done by the Western Pacific, and is included in all these statements; I so understand it. The item, excavation 786 lineal feet at $16 a foot, was for driving the tunnel. The lining of the tunnel, and the construction of the 66 feet of cut and cover work must have been done by the same gang at the same time. No, one could have separated that. It is, perhaps, something of an assumption, but I think it is a very natural one that that statement covers the whole cost of the work.

Questioned by Mr. Searls.

As to whether this information was taken directly from the Western Pacific books, I asked Mr. Olney if he could not find out for me what it cost, and this is the result; this is all I know about it.

Mr. Greene: Mr. Olney told me that these figures did come from the books, and that they were reported as stated here.

(Counsel for Defendants stated that he would like to be permitted to have a man look over the figures of the Western Pacific from which these costs were made up, in order to satisfy himself that there were not any sub-contracts that were not accounted for.)

6939 Mr. Hazen: The substantial difference between this estimate and Mr. Lawrence's figures is this: That Mr. Lawrence understood and reported that the cost of driving the tunnel was $9, and this states it was $15 a foot, an increase of $6 a foot.

It must have been sub-contracted. The materials shown by this schedule were a little more than estimated by Mr. Lawrence, but that difference is not very great. His was an estimate, and he came, perhaps, as close as could be reasonably expected.

Questioned by Mr. Searls.

I don't know that the sub-contract, if it was a sub-contract, covered the same work that the main contract did. It may be that the responsibility for various things was kept by the main contractor, and it may be that the main contractor supplies the sub-contractor with certain materials and facilities. Without knowing about that, I don't think I would pay much attention to the sub-contract. I cannot say whether Mr. Stone had the contract for all the Western Pacific construction between Oroville and Oakland.

6940

CROSS EXAMINATION BY MR. SEARLS.

I mean by free air tunnels a tunnel in which compressed air is not used. All the tunnels we have had under discussion here have been free air tunnels. You asked me if those included all the tunnels I knew about, and I excluded from this statement the tunnels in which air pressure was used in driving, caisson work. That is not applicable. The cost of driving tunnels in compressed air is very much greater than the cost of driving tunnels in the open, and it would not be fair to include any data of that kind in this list.

Questioned by Master.

I do not mean to exclude tunnels in which compressed air was used to run drills, or where air was blown in to ventilate the tunnels. Many tunnels are driven, for instance as the Merced Tunnel may have been driven, by putting in an air lock at either end, and pumping in so the men will work under air pressure, the air pressure being sufficient to balance the tendency of water to come in, so that the tunnel could be driven easily and without any expense as to water. The Pennsylvania tunnels under the Hudson River were driven by compressed air. 6941

CROSS EXAMINATION BY MR. SEARLS.

Referring to Exhibit 138, the table attached to the exhibit was made up by Mr. Lippincott and me, jointly. I had seen the figures for indirect and overhead costs on the Los Angeles Aqueduct before we made up the table. We started to make certain segregations of our percentages for pipe lines, telephones, roads and trails, building construction, power lines, divisional administration, and so on. I talked over with Mr. Lippincott each item, and then we separated that item as nearly as we could in general terms, without going into details, into how much of that would have been paid by the engineering department and charged to supervision if the books had been kept as the books have been kept on Eastern jobs that I have known about, and how much of it would have been paid to the contractor, and would 6942
have gone into his contract prices. I think we discussed that, and settled each item as we thought the facts were, as nearly as we could estimate them. Certainly there were no preliminary trials. We had no idea where we were going to arrive until the figures were all determined and afterwards added up. The fact that I knew the answer had no bias with me in working the problem out on lines that would make it come out to fit the answer; if I had any bias, I do not know it.

I have alloted to the supervision charges one-quarter of the indirect charges on buildings for construction purposes. I had in mind that all the local offices would be needed in the way of buildings for general supervision; all the buildings and vaults for temporary storage of note books, records and plans, and the houses in which the engineers and inspectors lived; everything necessary in connection with the supervision would be carried to the last column.

I won't undertake to state what the facts were on the Los Angeles Aqueduct, but on important construction it is not a good plan for the general engineering inspectors to simply have a little room in the field in one of the buildings used by the contractor, or to occupy the guest room at the bunkhouse when they made their inspection trips. On small jobs buildings sometimes are divided in that way. 6943

The buildings for my engineers on the aqueduct would cost about $90,000. I should say they must have had pretty cheap buildings put

up if they put them up for that money; that looks to me like a pretty low appropriation to house the officers and the men on construction work of that kind. These division superintendents on the aqueduct performed a double function. They acted as engineers, and also as superintendents of construction. In this separation it is necessary to separate that approximately, and we did separate it half and half as getting an approximation as to what was engineering, and what was construction, as nearly as we could do. Of course, the same men did both, but there is no record of how their time was divided, and there is no way of ascertaining now by any examination of their records how much of a man's time should be charged to engineering, and how much to construction, so that half is an approximation. When it came to buildings, so far as they were used by these men, and for these pur-
6944 poses, a corresponding separation would take place. If all the buildings were used for general purposes, then, of course, they would be divided half and half in the same ratio as the salaries; as a matter of fact, though, I think, from talking with Mr. Lippincott, there were many other buildings used for other purposes, and so the half and half ratio would not apply to the buildings; it would be modified from that.

As far as these buildings were charged to aqueduct, I suppose they include all the bunkhouses, cookhouses, and everything else. As far as they were furnished without being paid for by the aqueduct, I suppose that statement is not correct. When I made this segregation I did not have in mind any other large construction where buildings for the general staff amounted to any such ratio as this to the general costs. There is a lot of expense for buildings; you have to furnish good, comfortable offices, draughting room, and places where the records would be kept and where they would be safe. On a line as long as this it costs a great deal of money to build such buildings.

6945 My experience is that the permanent buildings that are wanted afterwards are never available for construction purposes. As construction camps are built, and the construction approaches completion, the people know then where they want to live, and where the permanent houses should be; a location of permanent houses for operation is very frequently entirely different from locations that are applicable for houses for construction. Houses that are put up for construction are often not available for operating purposes. The Sunol cottage, near the Water Temple, might have been used as headquarters to some extent, and the San Andres cottage might have been used if it were available at the start. There is a cottage at Pilarcitos, but I do not think those cottages would be very well adapted to construction offices. Some of the men might have lived in them, but I think the construction offices would have been built.

6946 I am not making any suggestions that these percentages apply to Spring Valley construction essentially; I am simply trying to find out what happened at Los Angeles, and to get something of a rough,

over-all comparison with the Spring Valley conditions. When it comes to individual items, I don't think there is any contention that prorating them from one system to the other could be done. I don't think the total is immutable. I think the conditions may affect the total as well as the items.

I have apportioned a quarter of the pipe lines for construction and domestic use to the general supervision, that is, interpreting domestic, to include all the uses of the engineering department aside from construction uses. I think there are several of the Spring Valley houses where the water supply cost more than the house. There undoubtedly would be a difference between San Francisco and Los Angeles in that respect; the water supplies of Los Angeles would be 6947
somewhat more difficult on an average to obtain.

Mr. Lippincott: I found an auditor's report from the City of Los Angeles for the year ending 1914, in which, on page 221, the general governmental expenses of the city are summarized for a period of six years, extending from 1909 to 1914, inclusive. I have checked it with the Census Report which was referred to the other day, and it is somewhat different. The matter stands this way: The general expenses of the city government, including the Assessor, the Attorney, the Auditor, Civil Service Commission, Clerk, Council, Custodian of Buildings, the Efficiency Commission, Elections, Litigation, Mayor, Public Works, Tax Collector, City Treasurer; I have left out of that enumeration the Police Court Officials, the Municipal Art Commission, and the Prosecuting Attorney. That leaves for the fiscal year 1913-14 the net sum of $342,376. Those offices that I have enumerated are 80% of the total when you include the Police Court, and the Prosecuting Attorney's Office.

On page 221 I find the general expenses of the city government given:

For the year 1909	$253,774	6948
For the year 1910	359,576	
For the year 1911	359,895	
For the year 1912	365,400	
For the year 1913	515,335	
For the year 1914	427,971	

Applying this 80% ratio in order to reduce it specifically to the general executive departments of the city government, you get these figures:

For the year 1909	$203,219
For the year 1910	287,651
For the year 1911	287,916
For the year 1912	372,320
For the year 1913	412,268
For the year 1914	342,376

So, for the six year period the executive departments of the government proper, exclusive of police court affairs, amounted to $314,394 as an average. That does not include any of the expenses of the Board of Public Service, which is the water department. Mr. Mulholland's services were included in the expenses of that department.

I think the 5.30%, as shown in this table, at the end of Exhibit 138, of Los Angeles Aqueduct, indirect expenses, does include that
6949 service of the Chief Engineer. I am in error about that. There are two figures given here, general offices and executive 5.3%; then below is given general city offices, a charge of $94,000 a year, amounting to 4.7%, and that latter amount did include the services of the Chief Engineer.

Mr. Hazen: That is right.

Mr. Lippincott: These figures that I am reading now are lower than the census figures. I don't think that you could say that either one is exactly right or wrong; it is a question of classification of accounts. The figure $300,000 odd that I read is not comparable with the $750,000 in this exhibit.

Mr. Hazen: The $750,000 was for the whole period, and the $300,000 was per annum.

Mr. Lippincott: The figures I gave from the Census Report were properly copied, but they gave a classification called "All general departments of the city government". They averaged for the period from 1908 to 1911, $653,000. This summary that I have for the City
6950 of Los Angeles is for 1909 to 1914, inclusive, and they average for that period $392,992. Apparently, there is a different distribution of accounts in there that I cannot fully account for.

We took a charge of $94,000 a year which we made against the general expenses of the City of Los Angeles in the Public Service Department, which is the Water Department. Now, if you consider the Public Service Department as contributing $20,000 a year toward the expenses of the aqueduct, which I think would be quite reasonable, that would leave $74,000 a year to be provided from the general funds of the department, which, according to this classification that I have now, by the Auditor would be 23½% instead of 19% of the executive expenses of the city government. I don't think there is any radical difference in there. I don't care to change my 4.7%. I was just simply making a study as to the reasonableness of this charge of $94,000 a year. About half the expenditures of the City of Los Angeles for that period were for the aqueduct. When I speak of the year 1909,
6951 that would refer to the fiscal year 1908-09, terminating on the 30th of June. Reading those figures down, we get $203,000, $287,000, $287,000, $372,000, $412,000—that was the year in which the aqueduct was finished; in 1914 it dropped to $342,000 for those expenses. In

1910-11 when the aqueduct construction was shut down our expenses kept right along.

The aqueduct construction was finished about in May or June, 1913. In the following year the general expenses of the city government were reduced $70,000. I am not saying it is on that account, but it is just as fair to consider that that way, as to consider it from the other end, and perhaps more so. I think we drove our work the hardest, probably, in the last year of the work. There was some harbor work in Los Angeles in 1913, but I do not remember just what it amounted to. During these entire six years there was very heavy 6952
construction practically all over Los Angeles. The city was growing very rapidly, and we had to meet that growth with improvements in nearly every line of public construction, but I am not so sure that that would necessarily make the figures for those years higher than in normal years. Those expenses are expenses that are quite persistent, City Auditor, City Attorney, City Council, and things of that sort. I think when you have construction work it is necessary to give each of these departments more money than ordinarily, to handle it. It is 6953
my understanding that the cost of the assessment is charged against the project where assessment work is done, as in the case of the Twin Peaks Tunnel, in San Francisco.

Questioned by Master.

Mr. Hazen: Taking the figure 13.7%: That is 17.38 divided by 126.64. We started with 100% direct construction cost, and we added to that, out of this classification, 26.64 of other costs, which were really part of the construction, so that the 17.38 is to be reckoned on 6954
the whole construction cost, and not on the 100 we started with.

Questioned by Mr. Searls.

I stated, on page 15, Exhibit 111, which contains my general brick work data, that the labor cost at San Francisco is at least twice as great as it was at Albany when this work was done, and by labor costs I mean the wages paid for labor.

Mr. Searls: Q. I have here a sheet, compiled by E. M. Craig, Secretary of the Builders' Association in Chicago, showing the rates per hour paid in the building trades, and the hours worked per day in various cities in the United States during 1915. It shows that the wages paid bricklayers in Albany that year were 65 cents per hour; to common labor, 22 to 30 cents, or an average of 26 cents per hour; that during the same year in San Francisco bricklayers were paid 87½ cents per hour, and common labor 31¼ cents per hour, which shows an increase in the bricklaying trade of only 33 1/3%, and common labor of only 20%; the hod carriers at Albany were paid from 25 to 35 cents per hour, or an average of 30 cents, while in San Francisco they were paid from 50 to 62 cents per hour, an average of 66 cents, and showing an increase of 87% with regard to hod carriers. In view of these figures in 1915, are you still of the opinion that in

1913 there would be 100% difference between the San Francisco labor cost, and the cost at Albany? A. I am not comparing the cost of the labor in San Francisco in 1913 with the cost of labor in Albany in 1913. If it were so, the statement obviously would not apply. I am comparing the cost of labor in San Francisco in 1913 with the cost of labor
6955 in Albany in 1897. For common labor you read that the going rate in Albany was 26 cents per hour. For common labor on this work the actual going rate was 13 cents per hour; in other words, the going rate on common labor was doubled between the time this work was built and the time your statistics were filed.

Questioned by Master.

In principle the labor from 1907 to 1913 was the period covered by me, but as a matter of fact, I think the change was not very radical during that period. There was a tremendous increase in wages in the 10 years before that period, and it reached the high point in 1907; by high point, I do not mean everything was high then, but it came to a very pronounced summit, and after that the increase was not marked. In some cases there were temporary decreases. I am sorry this Albany experience is not dated; at any rate that was done about 1897 or 1898. There was no Bricklayers' Union when we started that work, although the bricklayers were organized and joined the union before it was completed.

6956

CROSS EXAMINATION BY MR. SEARLS.

I cannot give you any detail of the labor cost on brick work of $15 a thousand, which appears on page 14 of Exhibit 111. If I took the Albany work as a direct indication, it indicated $18 per thousand for San Francisco conditions. I don't remember that I have ever done any brick work that was any more economically done than this Albany work. If you could tell what you could get a crew for here, and what it would do, that would be a better basis than to take a job in Albany and try to determine the cost of a job in San Francisco by applying percentages to that, but I have not any information, or any data of that kind. I very much doubt if any brick has been laid in San Francisco suitable for hydraulic work, as I think these brick were, in recent years. A great deal is laid in building construction, in walls, which I would not take as any indication of the cost per thousand of placing brick in hydraulic construction. I have had no experience with gas
6956½ holders. I don't know what they would do, or just what is involved. If I got data as to gas holders, and found that the construction was
6957 comparable, I should certainly consider them.

RE-DIRECT EXAMINATION BY MR. GREENE.

Referring to the compilation made by Mr. Lippincott and me: We did not make a written record of all the things we talked over, but I should say that about half the buildings represented probably

went with the administration, and by that I mean serving the men who acted as representatives of the city on both the construction and engineering, and the other half of the buildings represented storehouses and laborers' quarters, and construction buildings of every kind, and that the half of the buildings that were occupied by the men would be divided in the same ratio as the salaries, half and half—that would make a quarter.

Witness: J. B. LIPPINCOTT re-called for Plaintiff. 6958

DIRECT EXAMINATION BY MR. GREENE. Lippincott

I have checked up the tunnel costs which Mr. Searls asked me to. These were certain tunnels that Mr. Searls had given his figures on, and which I understood he got out of a certain text book, and which I have compared with the actual cost records which I have here, and which may be consulted.

To represent the direct cost, exclusive of any indirect cost, the first is Tunnel 1-B; that was finished in May, 1912, and its cost is given in our cost record, page 2175; these show as follows: Excavation, $9.51 a foot; timbering, $1.90; dry packing—that is packing stone behind the lagging—4 cents a foot. The superintendence is put down as 7 cents a foot; I divided that in half, because part of that should be charged to the lining, 3 cents a foot; engineering, which means surveying, ½ of 19, 10 cents a foot; ½ the added proportion, 9 cents a foot. I do not think the surveying is an indirect charge in that case. It is not very material, and I am willing to take it out. Superintendence and engineering amounts to 13 cents; the total is $11.67 a foot. The figure given me by Mr. Searls was $10.35, and I think the figures given in this book of Brunton & Davis are figures that were obtained during the time that the work was going on.

Tunnel No. 2; the figure on that is $18.88, and the figure Mr. 6959
Searls gave was $12.28. In that particular case there was a cave in the tunnel. The cave broke the timbers through, and caved to the surface of the ground. After efforts we abandoned the true line of the tunnel at that particular point, and ran around it. The charge on account of that cave was $4.14 a foot. That was in as a direct cost. I did not use this tunnel at all in my comparison. In this particular case that was used as a direct cost, and independent of this 33% for indirect charges that we talked about. That is the way it was entered on the books.

Tunnel No. 2-A, page 2232 of the Cost Reports; the total is $12.11, and the figure given by Mr. Searls was $10.72.

Tunnel No. 44, page 1303; the direct cost was $13.05 as against $10.84 given by Mr. Searls.

Questioned by Mr. Searls.

I don't know what the probable error was in your figures there. There is this to be said about Tunnel 44, and I presume this is the explanation: This is the unit cost for driving one end of Tunnel No. 44. The other end of Tunnel No. 44 was averaged in with the cost of
6960 driving Tunnel No. 43. The two ends were very close together, driven by the same camp, and I could not differentiate between the two. This, as I remember it, was distinctly the cost of Tunnel No. 44. I don't remember that the other end of Tunnel No. 44 was easier driving. I don't remember either one way or the other about that.

Tunnel No. 50-K amounted to $11.27 as against $11.22 that Mr. Searls used.

Dockweiler

Witness: J. H. Dockweiler re-called for Defendants.

DIRECT EXAMINATION BY MR. SEARLS.

Counsel for Defendants offered a corrected exhibit to be substituted for the first page of Exhibit 141, covering the correction as to hours on those tunnels where Mr. Dockweiler used 9 hours, and correcting the Lake Merced Tunnel figures. There was no objection to the offer.

Mr. Dockweiler: I have corrected the figures on the following tunnels where I used a 9-hour day before, so as to show the cost on an 8-hour basis; Pilarcitos Tunnels Nos. 1 and 2, Stone Dam Aqueduct Tunnels 1 and 2, Davis Tunnel, Bald Hill Tunnel, and Crystal Springs Tunnel No. 1. All the other tunnels I figured on an 8-hour day.

6961 I corrected my Lake Merced figures, because those photographs showed me there was more timber used than I had estimated on, so I made some new figures taking that into consideration. I have increased some of the tunnels on the Peninsula for the reason that in adding up the totals I took unit costs for some of them, on the basis of one-quarter timbered, when they should be figured timbered throughout their entire length, with the exception of Pilarcitos Tunnel No. 1; that I have assumed is one-quarter timbered. I have assumed all the other tunnels wholly timbered in the Peninsula sections, with the exception of the tunnels at the Crystal Springs Dam. In Tunnel No. 1 on the Crystal Springs pipe line there was no timbering at all.

Referring to the ninth column, on the first page, giving "Cost, miscellaneous, per foot": That is merely a division of the total cost of the incidentals by the length of the tunnel. For instance, take Lake Merced Tunnel where the incidentals are $6.18; that is made up of the excavation drain drift 773 feet; the shaft 170 feet, and the pipe. Those items total $18,779.30. Dividing this total by 3,036 feet, the length of the tunnel, it gives $6.18. The tunnel auxiliaries include those items which are outside of the driving and the lining. That is,

"Cost, miscellaneous, per foot" includes the tunnel auxiliaries on the Merced.

CROSS EXAMINATION BY MR. MCCUTCHEN.

In arriving at my figures I am conscious of my experience in the tunnel in the Los Burros District. If I did use it, my figures would be lower. The Los Burros Tunnel is being driven through slate. I have been down to the Los Burros many times, and have seen slate where the mine is located. The vein itself is in between two walls of slate, which stands pretty nearly vertical. The tunnel is in about 400 feet now, but I do not remember it has been driven by this contractor, though he has driven some. The records of the work are in the office of the secretary of the company, Thomas E. Haven, Attorney-at-Law, in the Balboa Building. I signed a check for part payment of that last 100 feet, and I know that it was at the rate of $6.50 a foot. 6962 6963

I don't know when the contract was let. It was probably a year ago, and I don't remember now how much this man has driven. The size of the tunnel is about a yard to the foot. I designed it so that when the track is in there there should be at least six feet in the clear. If it is timbered, it will have to be 6 feet 2 inches above the tie. We gave the contractor the rails; the company owns the rails and the car. There is no power plant there. He is driving by hand, and is blasting. I don't know that he is blasting all of it, but I should imagine he would be doing so. I have not been in that tunnel since we started, but I have examined adjoining work within a few hundred feet of that work. I don't remember having been in this particular tunnel, but I know the material, because there have been tunnels and drifts run right within a few hundred feet of that spot, and the material is the same. The material might change in a few hundred feet, but that is a slatey formation there, and I do not think there is much change. 6964

I don't remember what these tunnels within a couple of hundred feet of this Burros Tunnel cost, but after sizing them up, I made an estimate of $8 a foot to the company for driving this long tunnel. The slate was not so very hard. It was, I estimated, $8 per foot material. I do not say that a tunnel can be driven in tough slate for $8 a foot, but it can be driven in that material, and that material, in my opinion, is no more difficult to drive than the Spring Valley material; that is the best comparison I can give you.

A crew that I could put on there should make in 8 hours three feet, with hand drilling. I would use the same crew and the same shift that I have estimated for the Spring Valley tunnels. I would reckon two shifts of 8 hours each. 6965

On the Los Burros Tunnel I would have two miners and one mucker. I would have a blacksmith divided for the two shifts, a timber man divided for the two shifts, and I would have a foreman; or in other words, I would have a total of nine men working on the two

shifts. You can divide them up. With that crew of nine men I would make in that formation down there six feet, or three feet a shift. I have not estimated that quantity for here at all. I haven't gone into the detail of how many holes those miners would drill into that face. I didn't figure how many holes they would drive in that face to the shift, and I could not tell you offhand what footage they would make. The number of holes they would drive into that face would depend
6966 upon how your particular face sized up, how it was left from the previous shooting. That is as nearly as I can tell you about the number of holes I would have driven into that face down there.

I know that it is $8 material, and I based that entirely on judgment down there, and I was confirmed in it when we let a contract for $6.50 a foot, we supplying the material. I have not made any estimate at all on how many holes I would drive in that $8 material. The crew that I have given you would be, during those 8 hours, drilling, gadding, putting in a pot shot now and then; they would be bulldozing some of the work, and using picks on it to the extent that they could. They would put in a few holes; I don't know offhand what length of hole I would put in. I do know that I could handle that for $8, and I made that estimate to our company. In making that estimate, I did not assume anything at all as to the number of holes that these two miners would put in the face, or to what depth. My experience has been that that is the crew that is required to do that
6967 work. I drilled, I think, 300 feet of tunnels right in the foothills in back of Fresno in that kind of slaty ground. I don't know what the geologists call it, but it is what I call slate. I sunk a shaft there in what I call a very hard schistos slate. I do not know whether any geologists call that slate or not. I have not seen any geologists' sheets or atlas of that section to regulate what they call the formation. I am sure that it was not sandstone. Those tunnels were in the foothills, but I do not remember the elevation. It is about 24 miles from Fresno by wagon road, and about three miles off the main county road in the foothills. Some of the material could be picked down, but most of it was shot. I cannot tell you whether a large percentage of it could be picked down. It depends upon the judgment of the man pointing his holes, and jarring up his face. After over-shooting I know there was trouble loosening and picking off, using a sledge hammer to break off the sharp points. It depends entirely on the ability and judgment of the miner how he puts his hole and takes advantage,
6968 shooting toward a seam, and all that. A miner knows how to point his hole. Then he will take advantage of the seams as they appear, and shoot toward them. He points his hole so he will break his ground toward the seam so he will loosen up a large area.

I have found out that those men that are there in the face, that that is their business, and it is a foolish thing for a man to tell them how to point their hole. You can see the last shift has done so and so;

you can tell the difference between a green hand and a man who knows his business, and an experienced miner who has done hand work doesn't need any directions at all. If I went into the face of such a tunnel, and the miner was not doing the work properly, I would have a pretty good idea of how to tell him that he was not. For instance you observe the work, and the results. You keep a record of your footage. You know one shift is doing so much, and that another shift is not. Then you say, how are those men pointing their holes? How much powder are they using? To what depth are they drilling? You cannot lay down a theory of it; you must apply your
own judgment to each particular job you are working on. If an en- 6969
gineer has a good crew of miners, he doesn't need to know anything about it.

In the hands of experienced miners a job would go through if an engineer would leave them alone. A man who knows his business will not interfere with the details of the workings of men of that class.

The Fresno tunnels were not tunnels that could have been driven by an auger, because the material was too hard. I remember we put in about two small shots, and the material came out blocky. You could crowbar it out, and loosen it with picks. I remember we put in
a great, big, deep cut-in shot. A cut-in shot is in the very center of a 6970
drift, and is generally driven on an angle for the purpose of removing a wedge, and then from that, break the sides loose, and toward the end when you have got that, you drive a hole in the bottom, which we term a lifter, and you pile a lot of muck over that, so that in addition to shooting out its own cut, it will throw back the shot of anything that has been shot before—holes that you have split your fuses off to go off ahead of this lifter. I have seen the heaviest part of the charge put in the center of the drift, and I think that is good mining according to the conditions under which they were working. I do not think he would throw out as much rock that way as if he put the greater part of his charge in his cut holes, and in the holes on the sides; you want to break out a wedge so as to have a place to shoot through, and hence you always get that center cut going off first.

I think those Fresno tunnels were harder than the Spring Valley tunnels in some places. On an average I should say that that was harder rock, and I am positive that augers could not be used there. I don't think you could use augers in the Spring Valley ground.

An auger is just what its term indicates. The kind with the 6971
screw arrangement on the end of it, such as you use for boring through wood, is an adaptation of it. I have seen the augers used on the Los Angeles Aqueduct, and they are just as Mr. Lippincott described them. You take a piece of steel and make a few turns on it and twist it, and at the very bottom you make a cutting edge of it by dividing the flat part of the bottom, and turning one piece one direction, and the other the other direction, and sharpening them. I think

they put a lop or hole through the end of this, and put a cross-piece on it, and a little exertion on that. I only saw that in the sandstone in the smooth going. I didn't see that in any hard rock. I saw it in the aqueduct, but I do not even remember the description of it. It was stuff that you could auger in. That is the way I should describe it —sandstone.

The crew that I mentioned would in 8 hours make $2\frac{1}{4}$ feet on one of the faces of the Spring Valley tunnel. They would drive and timber $2\frac{1}{4}$ feet of tunnel. I don't think I would drill anything
6972 deeper than a 3-foot hole, and I think with your picking and gadding it would give you $2\frac{1}{2}$ feet back from your face. I might drill 3 or 4 feet, but whether I would put in only one hole depends on the material entirely. It varies in there. Two miners will drill say 6 holes per shift. In some cases I say here, very little drilling. I say roughly 4 holes 3 feet deep, and 2 holes 1 foot deep. That would give you 14 feet of holes. In some of that formation they might drive 14 feet on a shift or 7 feet each. In some of it they won't do that, but they will average in my opinion that right straight through. Unless I have the formation of each foot I could not determine that, but that is the estimate that I have made. I have seen men drive on the average of about a foot an hour in material of that kind. I have done that myself on the Fresno work. I have had rock so hard that a man would not do more than put in a 16-inch hole in 8 hours sinking a shaft in my Fresno work. I would not expect to encounter work of that kind here. That
6973 Fresno work was a schisto slate. If I fired a hole of more than a depth of 16 inches, I would load her up and choke her with powder and shoot that bedrock out. I could not break her. It was very hard material. I am talking now about sinking a shaft in the schisto slate. I didn't run across any schisto slate in driving the tunnels.

I don't remember what footage my men made when they were driving the tunnels. I contracted some of it to the men, and gave them $6.50 a foot, and furnished them with the powder, drills, rails and car. We used no pump at all. I paid them $6.50 a foot for the labor only. I don't remember how many feet they made a day, but they were making good wages, because as soon as they could not make good wages they dropped the contract, and they stuck on this work until it was finished. I think I drove about 150 feet on that, and the reason I let out that contract was that I wanted to go away.

6974 Your muckers will do the track laying. I have seen a mucker in a mine doing track laying in Fresno, where he did it for me. It might be a question of classification; if he would not do it as a mucker, I would call on a laborer at $2.50 a day, and then he would do it. I didn't make any inquiry. I didn't make any inquiry as to whether any mine in the state gets its muckers for $2.50 a day. The

contractor I have on that Los Burros Tunnel gets them for that, and if he was not making money on that work he would quit it. He gets $6.50 for driving the tunnel, and he is doing all the timbering. I furnish him the timber; he has the rails there and the car. He is paying for the balance of it. The only time we figure in the matter is when the tape line shows he has done a foot, and then he gets $6.50 for that. Whether the mucker lays the track, or whether the timber man lays it, that crew that I mention will do that work. 6975

The Pilarcitos Tunnel is only 1,495 feet long, and is timbered one quarter of its length. The crew of one timber foreman, 3 miners, 3 muckers, a blacksmith, and 2 timber men, is the crew I had for two shifts. If I stated 3 miners, that must have been another arrangement. I have the crew here for Pilarcitos No. 1, 4 miners, 2 muckers, 1 foreman, a timberman and a blacksmith. When I get to Tunnel No. 2 I increase that, I have 4 miners, 2 muckers, 1 foreman, 2 timber men, and 1 blacksmith. The reason I have 2 timber men in this tunnel is that it is timbered all the way. I have 1 timber man less in Pilarcitos No. 1 because I assumed that it is to be timbered only one-quarter of the way.

On page 6737 of the transcript I said "As this tunnel had to "be timbered all the way, the rock would be comparatively easy to "handle. I have estimated that the following crew will make 5 feet 6976
"a day in one heading, in 2 shifts of 9 hours each: 3 miners, 2 muck-"ers, a foreman, 2 timber men and a blacksmith." That is correct, but I should here add 1 miner. I have it here at the bottom of the record, and I should have read that in in addition. I don't think I said that after the tunnel got in a certain distance I would have another miner; I think that extra man would be in there taking care of the water for drainage, and I have made that allowance. If you were on the inlet end or the outlet end you don't need any man; your tunnel will drain itself. The muckers would load up the muck and car it out; they would help the timber man, and be generally busy on the job. I figure them as being car men too, and they would actually take all that material out of the mouth of the tunnel. I think they would make, after the tunnel had got in 1,000 feet, 11 carloads in 8 hours. In a 2,000 foot tunnel it would be a 1,000 foot haul at the maximum, and in a 3,000 foot tunnel would be a 1500 foot haul at the maximum. I think he could travel it at the rate of about 2 6977
miles an hour, and in 8 hours he could certainly negotiate those 11 trips, even from the far distance in.

I would keep my powder outside in a little shack. I would run a drift in, and put a few boards over it, and put a couple of boxes of powder there, the way I have always done. I would have, say, 5 boxes, and a few rolls of fuse, and some extra caps. Miners, after they get in a couple of hundred feet cut a hitch in the side of the tunnel, and keep their fuse and caps there. Their powder they would

keep outside. It is the despair of a mining man to make them keep
6978 the powder outside. They will bring it in. I would keep the powder 150 feet from the shaft, pointing it away from the face of the tunnel. I would put 3 or 4 boards over the top of it.

Kast Witness: MARIUS J. KAST for Defendants.

6979 DIRECT EXAMINATION BY MR. SEARLS.

I am 50 years of age, and reside at 753 Bush Street, and am Superintendent of Supplies for the Board of Supervisors. I have charge of making the annual contracts that are required to be made for the City and County of San Francisco. I have compiled the specifications for those supplies, and kept a record of the bids. I have before me, with the exception of the year 1911-12, the official specifications for the year 1907 to 1913, inclusive, showing the specifications on all brick purchases made by the City and County of San Francisco.

Questioned by Master.

I have held my present office for 4 years.

DIRECT EXAMINATION BY MR. SEARLS.

In the notice to bidders, the second paragraph reads: "The
6980 "quality of articles called for when not designated to be of the best "quality." Under the subdivision "Brick" it says: "The brick "shall be of the best quality. They shall be sound, hard-burned, "and purposely shaped, present regular and smooth surfaces, and "free from cracks." This bid for brick is for all those departments that the Supervisors contract for, and these contracts cover the departments that the Board of Supervisors are empowered to contract for, which includes the Board of Public Works, but does not include the Park Commission, the Board of Education, the Playground Commission, the Fire Department, or the Public Library. It does include the departments which have charge of the construction of sewers, and these brick which are purchased are for sewer construction.

Questioned by Master.

In the year 1907-08 no contract was awarded, but that does not necessarily mean that there were no bids. This record does not show whether there were any bids in 1907-08, it simply shows that no contract was entered into.

6981 Questioned by Mr. McCutchen.

The next year the same form of specification was used, but sometimes we changed them.

DIRECT EXAMINATION BY MR. SEARLS.

Taking the year 1909-10, it reads, "The brick shall be of the "best quality, standard size, 8 inches long, 3¼ inches wide, and 2½ "inches thick; they shall be sound, hard-burned, and perfectly "shaped, present regular and smooth surfaces, and free from cracks."

Questioned by Mr. Hazen.

There is no specification printed here on absorption.

DIRECT EXAMINATION BY MR. SEARLS. 6982

Taking 1912-13 it reads, "Common red brick; common red "brick shall be of first-class quality, uniform texture, burned hard "entirely through, free from cracks, and with true, even faces. "Broken brick shall not be brought upon the work. Samples of "any three selected bricks shall show an absorption of not to exceed "15% when half a brick is immersed in water for 48 hours, nor must "the ultimate strength under compression of any half brick, when "tested flat-wise, be less than 2,250 lbs. per square inch."

Taking the year 1913-14, the specifications read the same as for the year 1912-13 above exactly.

Questioned by Mr. McCutchen.

Mr. Kast: I know in a general way that they have a laboratory to test all these materials like cement and brick. I do not receive the deliveries. I make the contracts, and leave it to others to receive the deliveries and make the inspection. 6983

Questioned by Mr. Searls.

Materials which do not comply with the specifications are rejected by the city government. The departments do most of the rejecting, but if it comes under the observation of the Supervisors, they will not pass the demands. For contract articles, the demands do not have to go through the supply committee and be approved by them. The custom with contract articles is that a department requiring any material or supplies turns to the book, and there finds the price, and buys according to its own judgment.

CROSS EXAMINATION BY MR. MCCUTCHEN.

That letter of purchases is merely a copy of the price shown by these books.

Witness: J. H. DOCKWEILER for Defendant. Dockweiler

CROSS EXAMINATION BY MR. MCCUTCHEN.

I do not know anything about the requirements of the law with reference to the storage of explosives.

(Discussion here ensued among Counsel as to what the law provides in regard to the requirements for the storage of explosives.) 6984

Mr. Dockweiler: It would not cost more than $50 to put in a
small tunnel with an iron door in front of it. I would run in a drift
until I got head room enough to put an iron door in, and then prob-
ably run the drift about 4 feet further. You would have your ven-
6985 tilation going through a 2-foot pipe, sticking out over your door.
You hardly ever line such a place as that; I have never done it. You
have a couple of sticks, about 2 by 4's, and you set your powder on
top of them.

I have not assumed that it would require a very large quantity of powder in driving a tunnel 1300 or 1400 feet long. I would take half a ton on the job at a time. That would be 20 boxes. A team could deliver a ton; that is, half a ton at each mouth. I recognize that the handling of explosives is always more or less dangerous.

The witness was handed a piece of rock, and asked to characterize it.

Mr. Dockweiler: That is pretty hard to tell offhand, and just
6986 from a small piece. It might readily drill. I could not tell you how
many feet a single hand driller would make in that on a shift. I
would want to size up the situation, and see how it is situated,
and how seamy it is. Seaminess would have a great deal to do with
it in the shape of how it would break. If the seams are quite a
distance apart, I would not do much drilling. I would just put in
a pot shot, jar it loose, and crowbar it out. If there is quite a
seam, and it is on an angle, you would fit your drill to it. I could
not tell you how many feet a man ought to drill in rock of that kind
on a shift, unless I could size up the locality. I can't tell anything
from a small piece of rock like that. Assuming that you were work-
ing against a face like that. I could not tell whether a man would drill
a single hole of 5 feet in it in a day. I would not want to state
whether a man would drill a single hole of 2½ feet in it in a day,
unless I sized it up and saw the situation. I could not tell offhand,
assuming that that rock was found in the Davis Tunnel, whether a
single hand driller would drill a hole 2½ feet deep in it in 8 hours.
I don't know how much of it is like that. If you had a bar of it
6987 10 feet thick, I should judge a man would make a single hole 2½ feet
long in that in an 8 hour shift. I don't know whether he would
make more or not, but I should think he would make 2½ feet.

In order to break a 2½ foot hole 7 by 7 on that kind of hard rock, in the Davis Tunnel, a man would shoot that face with probably 8 holes. I don't know whether you would put more than 8 holes in a face 7 x 7, but I would try that out. The number of holes depends entirely on the rock; how she lies, and how she breaks with shooting. The largest number of holes that could be put in a granite face depends on whether the granite is blocky. I think I have put in as many as 9 holes in a hard face in a small tunnel. That rock in Fresno was hard rock.

The largest number I have ever seen shoved in was 9 holes on a 5½ x 6½ tunnel. The center hole was about 3 feet deep, and the 6988 side would not be so much.

On the Sunol Aqueduct I got drilling machines that cost $200 apiece, because I figured that in the Sunol I would have to use big machines to make the progress. I don't know exactly what course of reasoning I used, but that was my judgment, that I would have to have a pretty good sized drill over there. I wanted to get progress, and with a big machine you have some air pressure back of you, and you can punch a hole in in good shape. It is not my understanding that you can use a big machine advantageously in very 6989 soft material. My impression is that for that face I would use a big machine. If I could get a smaller sized machine to do it, I would have that advantage. On this Sunol work, I have on each shift 2 Burleys, 2 chuck tenders, 4 muckers, a mule driver, a mule, a shift boss, and a timber man. I figure I would have those two machines at one face. If the two machines do not need the 2 chuck tenders, the estimate is liberal. I have given you 1 chuck tender to each machine. The second chuck tender might be in the way, but I have made the estimate for him whether he is in the way or not. Generally a chuck tender goes with a machine drill, and that is the equipment I have used. I don't know that 2 chuck tenders would be employed in a small face where two drilling machines were working, but I cannot imagine how one chuck tender would be shifting from one machine to the other. I think he would be needed. I don't know it. In other words, then, my estimate is that much too liberal, but I have assumed that there is a man to each machine. 6990

I don't recollect ever having known of 2 men tending chuck on 2 machines on a tunnel face as small as 7 by 7, but that is my estimate. The chuck tender changes the drill, and whether you allow it or not, he is always hammering that drill with a wrench, and he does it whether you want him to or not.

On this work at Sunol I have worked 3 headings, and 3 shifts to each heading. I have it figured 4 feet a shift, and that is the estimate I have allowed. Two men would probably make more than 4 feet on a shift on a tunnel 7 by 7, but that is the allowance I have given. I don't know personally of 2 men doing that, but I would certainly expect them to do it, or I would can them.

The machines would make 4 feet on a shift of 8 hours in ma- 6991 terial like that you showed me a few minutes ago. I have never figured out how many holes they would drive into it. The footage which they will make in the drift is dependent altogether on the footage they will make in holes, but generally they will drive as few holes as possible to break. It is my judgment, from an inspection of those tunnels and the material, that they will make that. I didn't make any estimate as to how many holes a drilling machine would

drive into that face, because I couldn't tell offhand how many holes there would be. I don't recollect what is considered good footage for a Burley Drill to make in a day of 8 hours. It depends on the material whether a baby drill would make greater footage than a large drill. There are some materials where a baby drill will make the proper footage, and where a larger drill would not be convenient, as it is a heavier drill and it takes more time to set it up, whereas, with a baby drill a man would run it, and he might or might not require a chuck tender. If a man is going along easy
6992 ground, he might pull out his own drills on a baby machine, but I imagine that for ordinary material he should have the services of a chuck tender. When I say "He might pull out his own drills", I mean that he might have such easy material that he would get the full work from the size drill that he used without any trouble; he could just stop his machine and pull out his drill, take a wrench and unscrew it, and put it in shape again.

I have actually run a baby drill myself, but I do not recall ever having seen a chuck tender. I think I did have one, but I am not sure of it. I think I bought a Sullivan Drill; it was either a Sullivan or a Rand Drill which I bought in about 1900. That comprises my total personal experience with baby machines. My impression is that I did have a chuck tender on that baby drill when I shoved it down the shaft. I would not use drill machines on any of these tunnels on this side, but would run them all by hand power. That is not because I think I would accomplish more for the same money; I
6993 didn't see any necessity of getting an equipment in there.

I have never added it up to ascertain how many feet of tunnel I would have to run on this side. There are only 5 tunnels: Pilarcitos Nos. 1 and 2, Stone Dam Nos. 1 and 2, and Bald Hill. Then there is a tunnel at Crystal Springs Dam about 300 or 400 feet long, and also the Davis Tunnel, which I omitted; that is six altogether. The longest of them is about 3500 feet. The lengths are as follows: Pilarcitos No. 1, 1495 feet; Pilarcitos No. 2 is 3,426; Stone Dam No. 1 is 3,201; Stone Dam No. 2 is 3,530; Davis Tunnel 1,205; and Bald Hill 2,820.

It is easy to over-shoot material. It can be avoided in two ways. First, by properly placing your holes, and second, by not over-loading them. I argue from the fact that a tunnel had to be timbered throughout its entire distance that that kind of material was relatively easy to handle.

6994 I was not there at the time the Stone Dam Tunnel No. 1 was built, and as it is all bricked up, I had to take the testimony of a man who was cognizant of conditions when it was bricked. I would expect to encounter seams and laminations in a country of that kind in the driving of such a tunnel. It would surprise me if considerable water flowed through some of them. There might be water in

Pilarcitos No. 1, and in Stone Dam No. 1, but I don't think there would be any water to amount to anything encountered in the Davis Tunnel or in the Bald Hill Tunnel. From the rate of progress they made in the Stone Dam No. 2, as developed by the company's records, I don't think they encountered any difficulties there such as would be brought about by large quantities of water.

Running ground is such ground as if you remove a cubic foot, another cubic foot comes in; in other words, you cannot hold it. I have had that experience in driving tunnels in the outfall sewer in regard to sand. I have had my timbers crushed down, and where my cap was seemingly at a position 6 feet above the bottom of the floor, the next morning when I went in it was only about 5 feet, the whole set squashed down. I had not made any estimates on 6995
that in advance. I knew the time that it took to drive that tunnel, and I used the same time, so that that handles the conditions automatically.

I have taken the time that it took to drive Tunnel No. 1—that ratio—and assumed it here. The footage that we made there is what I have estimated here. I should expect a little running ground in these tunnels on the Peninsula, but not much. They would not have made the progress they did if they had found much.

If I were employed to drive a tunnel through similar material 6996
on the Peninsula, I would tell my employer that he could surmount the conditions to be encountered there, and make a profit at the prices I have given here. I would tell him that there is a chance of encountering running ground, but in my opinion there would not be much chance.

I do not assume that the tunnel work over on the Alameda side would be more difficult than the tunnel work on this side. They might be slightly more difficult, as they are larger tunnels. I don't remember how that actually worked out per cubic yard. The reason for providing for power equipment on the other side is that you have all your tunnels strung along in one line, and I think it is economically feasible to install power over there.

My recollection now is that I timbered Stone Dam No. 1, Pilar- 6997
citos No. 2, and Stone Dam No. 2, throughout; I assumed Bald Hill to be timbered all of its length. The size of that is $5\frac{1}{2}$ by $6\frac{1}{2}$, and I used timber 6 by 6. I used 2 by 6 lagging, also, and I covered the roof, and left space on the sides. I did not lagg it tight, I used 2 by 6 lagging placed 6 inches. I would not expect to encounter running ground in that tunnel, but if I ran across running ground, I would lagg it tight. In ordinary material, you use three lagging on a post, and if you do that, you have done pretty well. It depends on the nature of the ground.

If you had covered it from floor to floor, you would use 36 feet of lagging to the running foot, as against 72, which I have used. I

have assumed it spaced for 72 feet of lagging for a 4-foot set. If it were tight lagging all around, I would use 144 feet of lagging to a 4-foot set. For my sets I have used 74½ feet, for my lagging 72 feet, and then I have allowed 13½ feet for wedges. That makes 160 feet for a 4-foot set, and dividing that by the length of a set, it gives me 40 feet per lineal foot of timber. I have covered the two sides of the tunnel with that. I would not cover the floor on each
6998 side. On this I only have lagging every 6 inches. I have only covered half the surface with timber, and that is the average I have assumed right through. There may be places there, and undoubtedly there were, where you would have to lag it close, but there would be other places where your lagging would be in the nature of supports to hold up something, just hold it in place. The proper way to lag that tunnel is the way I have estimated it here. That is, I would lagg it tight in some places, and my estimate is 40 feet of timber per running foot. That checks out closely with Mr. Schussler's report as to what he did in the No. 2 Pilarcitos, as I recollect it. From my knowledge of that kind of country, I should say that it is probable that it would not be necessary to lag the entire surface of the tunnel.

I have only made an allowance for timber. I have timbered it right straight throughout sets over 4 feet; then I have assumed an average lagging, which would put in a 2 by 6 inch lagging, and then allowing a space and another 2 x 6. I have made allowance
6999 for timbers that might be crushed. My estimate carries all uncertainties in regard to it, because I am satisfied there would be long stretches that would not need a timber in it. I don't know exactly what happened. I don't know foot for foot. I have given you an estimate, and I am telling you that that estimate checks with a statement made by the chief engineer. As an average throughout, I should say that it would be safe for an engineer today, in estimating the cost of reproducing those tunnels, to proceed on the theory that they would be lagged only to the extent of 50%. I have had experience in tunnel construction—with a sand tunnel in the outfall sewer—that enables me to make that statement. That was the tunnel the horse fell in on the surface; the pocket was created by the cave-in of this running sand. Those tunnels were not only lagged on the top and on the sides, but the breast was tight lagged. We had that cave nearly in the beginning, when the contractor had tunnel men whom he tried to tell how to do the work.

7000 I lagged the Merced Tunnel throughout from floor to floor. My present estimate does not contemplate any spaces at all. I say timber probably 80 feet per foot. I don't recall the size of the tunnel. It is 8 feet 6 inches high, and its maximum width is 5 ft. 6 ins. It is an oval. If it were lagged solidly, it would take about 70 feet of timber to the lineal foot. The drawing, D-64, shows that there was no lagging on the two side pieces near the bottom. It shows

that only 5 segments of the circle are lagged, 2 segments on each side, and the top; the two segments, the bottom one on each side had no lagging. Figured on the drawing, it shows that 37½ feet B.M. per foot is the timber required, with the timbering as indicated 7000½
upon the drawing. My estimate allows you to lag that tunnel on the sides from top to bottom, and on the top. The 80 feet B.M. to 7001
2 inch material will cover that from floor to floor for a foot. That catches your heavy timber, because this section undoubtedly was used in some part of the work; without using this section to figure on at all, but judging by photographs which were introduced here, I changed my estimate, and allowed 80 feet per lineal foot. I have not figured the superficial area of one lineal foot of that tunnel from floor to floor. I have just taken the outline measuring by length of timbers in the timbered section. I did not specify my timber by size, but I should not wonder but what you might in some spots use as heavy as 12 by 12 in that 100-foot length. In arriving at 80 feet B.M. per lineal foot, I did not attempt to specify what timbers I have used. I merely made an allowance of 80 feet of timber per lineal foot. I did not designate so many posts 6 by 6 or so many 8 x 8; that I don't know.

The 80-foot B.M., I would say, is the bill of lumber I would assume that a man would have to buy, and that it would cost him $1.60 a running foot for the timber that went in there. How many feet of one size he would use, or how many feet of another, I don't know. I have doubled the amount of timber your records show, 7002
and that is all I know.

My estimate for the Peninsula tunnels, on the 4-foot sets, was 6 x 6 posts, and 6 x 6 cap. There would be 2 posts and 1 cap to a set. I only count 3 pieces of timber, 1 cap, 2 posts, a spreader, 2 shoulders and a cleat, and the lagging, and allowing excess lumber for wedging. I didn't go into the size of the posts on the Merced Tunnel. I don't think you would use much 12 x 12 timber, but I would not consider it unreasonable in that section to have 12 x 12 in about 100 feet of that heavy ground, and I imagine they would swash on you pretty heavy. By that I mean they would crush. The 80 feet B.M. per lineal foot would carry that. That total estimate 7003
of timber will drive that tunnel; I cannot tell you how much I would use in any one length of it. 70 feet will lag your entire tunnel tight, with 6 x 6 posts and caps. That is a rough computation here from this drawing. You might have to use 12 x 12; I am just telling you that in some sections you did not timber the tunnel in the bottom 4 feet on each side. Without making any assumption, I have allowed 80 feet. How much of that will timber it all, I don't know, but I do say that that is sufficient. Unless it is in running sand, it is unnecessary, in my opinion, to timber the very bottom, because some of that material is good standing ground. The record

made shows there, according to the profile, that in one heading alone there was an average of over 10 feet a day made. If that was running sand, or dry sand, you could not have made that progress. I think you could make more progress through comparatively moist sand, but if it is dry sand, with this fine mica in it that runs, it is pretty hard material. It is only by very careful poling and edging
7004 in, that you can get in the top posts of your tunnel. You shove them in one at a time, and you have to have a force set in your face while you are doing that. You have to handle the sides the same way. Dry running sand is comparatively more expensive work. I have had it done on work under my charge.

They have used a 6 x 6 timber in this drawing on that tunnel. I am satisfied they drove part of it with that, but on the lagging I would use 2-inch stuff, and it shows here you used lagging as wide as
7005 12 inches. I think 2 x 6 is a handier size to use. If you were using 12 x 12 timbers, that would represent about 26 feet a span; that is, the ring is 26 feet, and the 12 x 12 would be 12 times 26, which would be 312 feet, and dividing that by 4, that would be about 78 feet to the foot. I saved some on the lighter timber, but how much I could not tell you. I have not attempted to say that 100 feet of this will require this timbering, but am merely giving you the average timber. No man could give that to you unless he had the record of every foot of timbers, how they were used and placed in that work. I have not concluded that all that work was below the water level. I think some of it was, where they had this difficult driving, and I would say, where they ran across that really bad spot that was below the water level where they had difficulty that I would assume there was running water. I think I am justified in the assumption that it was in the nature of a pocket. I would not say that all that material was a homeogenous material. I would imagine some ribs through it, or some formations, by virtue of which
7006 this pocket was formed and confined; if it had not been of that nature, the water might have been equally distributed, because there is not much difference in the surface to indicate even the location of that pocket. I think the water was kind of concentrated.

My allowance for driving and timbering that tunnel is $6.50 a lineal foot. That does not include 100 feet that I would expect to be so heavy as to crush my timbers. The drift and shaft in my estimate represent $13,915. Assuming there is 200 feet of bad ground, this sum is nearly $70 per lineal foot of tunnel in addition to $13.50 per lineal foot allowed, or say, for the 200 feet of bad ground, about $83 per lineal foot of tunnel. I have given $13.50 a foot right straight through for the entire length of the tunnel, which is made up as follows: Driving and timbering, $6.50 a lineal foot; timbering, probably 80 feet per lineal foot, 2 cents, or $1.60 a lineal foot; ammunition 25 cents a foot; blacksmith supplies 50 cents.

The items altogether total $13,905 for the allowance of the wells and drifts which represent this bad ground. If this section is only 100 feet long, it is $139 a foot for that bad section, in addition to the $13.50 which I have allowed right straight through. Deduct $1.60 from $13.50, and that is the cost of driving that tunnel per foot. 7007

My total charge for explosives on this tunnel is 25 cents a lineal foot. The ammunition consists of powder and fuse, and I would not imagine you would use much. You might use powder in that sandstone rib that you have across there. I made the allowance, but I do not know whether they used any or not.

The aggregate footage of tunnels on the Peninsula is over 3 miles. There are 6 tunnels, and I think you could drive them just as cheaply by hand as by power. You might gain a little in time by driving by power, but I base my estimate on hand work entirely. It is my judgment that these tunnels would not justify a very heavy plant installation. I have resolved it, to my own satisfaction at least, that I would use hand work on the Peninsula tunnels, but I would use machine work on the Sunol. If you used machine work on the Peninsula tunnels, you might make 50% greater footage per shift, but there would be the trouble of keeping the muck out of the way. I don't know that the mucker would shovel the muck more than once; there would be some they would throw back. I would have a steel plate at the face of the tunnel, and would keep my rails shoved up pretty close. I would lay my track in small sections, and would have about a 6-foot piece in addition to my 30-foot rails. I would cut the rails up in smaller sections; then you could use the trick of shoving your rails, taking your long rails and laying them with the head towards the ball of the rail that is standing, and you could shove your car ahead on that, and go the length of the rail before you would make a permanent set. If you have your plates at the face of your tunnel, I would use 2 plates to shoot on, and then your mucker can shove very easily. Most of the material you would handle once, shoveling it right into your car, and throwing it on the dump. 7008 7009

I would not expect the miners to go right to work at the face after a blast; the men going in test up the face the first thing they do to know whether it is safe or not. Then an experienced miner will gad out, use a bar or a hammer, and knock off the points, and try to square it up as near as he can. In the meanwhile your mucker is shoveling out as much as he can, and as he gets to the face with a pick, he will draw that material back. To that extent, he will handle that twice. 7010

The miner, when he sounds his roof, will very often find that there are loose slabs there, and when he does, he will put in probably a trap, a post or 2 posts, or he may just shove in a wedge. He

will break down some loose points, but he will mentally say, I have been loading this too heavy, or I have been placing my holes too near the top; he would not have it happen to him any oftener than he could help. It will happen frequently, notwithstanding all his efforts, especially where his hole develops a formation; he may be working in an apparently hard rib, and he will get his round holes and shoot that out, and the ground is broken a little further, due to the change of formation, and he will find that he will have a sort of loose rock roof, which he will try and hold; he won't pull a lot out; if it is very loose, he will pull it out. In that way, it might come that he would have at times a hole 18 or 20 inches, or 2 feet deeper than he would like to have, and that frequently happens. It is a common experience in running tunnels for a miner to go in after a blast and find that a lot more material has fallen out of
7011 the roof of the tunnel than he would like to have fall out. That is with the best miners, too. He will timber that off, and the mucker will throw a lot of waste over on the top, if he can do it. In other words, he will get his set in there, and he will throw a little waste on the top of the set. He will put in his lagging there, and he will get in a little waste. What he will do is this: When he gets to that bad spot he will have his set of timbers and have his lagging. He has the hole above his lagging, and he will fill in there by putting in a few chunks of rock to kind of hold that, and on the next round
7012 he will not break up to that lagging. He will bring his timbers up as close as he can. Then he will put a false face in front, so that the blast won't knock his cap down, and won't hurt his posts; if he has to get up that close in that kind of ground, he don't use much shooting; he will do a lot of crowbarring and picking, a lot of wedging. That is apt to happen in all underground work, but where you have that running ground, you do not do much shooting.

Referring to the Peninsula tunnels; if I was going to run these with air, I would put a plant in between Pilarcitos Tunnels Nos. 1 and 2, in the San Mateo Valley, and would run both of these from one plant. It would be a pretty long stretch to catch Stone Dam Aqueduct No. 1 with a plant near Stone Dam No. 2, and the more I think about it, the surer I am it would be cheaper to run that by
7013 hand. You have got some pretty long lines to carry; how long, I do not know, but it is over a mile if I can recollect from the outlet of Stone Dam No. 1 in the Stone Dam Aqueduct to the inlet of No. 2, and you would have to heat that air after you got it. The longest air line that I have ever seen was in the Elizabeth Lake Tunnel, and I think one of those was pretty nearly 2 miles long in that face. I don't know whether they heated that air, but running it outside, I would imagine if you had a very long line, you would heat the air when it got right at the other end. I don't remember whether they did that in the Elizabeth Tunnel or not. I

could not tell you offhand what distance you can carry air without the necessity of heating it, but I do know you would get economy if you kept your air heated.

The buildings that you would allow at each portal would be—you would have a blacksmith shop, and you would have a little shop for cement; you might have about 3 small buildings at each portal. I don't know as I have specifically allowed for them, but I have built a little shop that I would use; I could not imagine anything larger that I would require for blacksmiths tools. They would not 7014
exceed $100 for a whole set of tools, and the building would not cost over $50. I would have 1 furnace in my blacksmith shop, and would have only one blacksmith shop for all the steel the shifts would use doing hand work. I would use blacksmith coal for sharpening the tools. I don't know whether I would use any charcoal or not.

In that place of mine, where we had to carry things 10 miles on a burro, we carried Cumberland coal in there, and did not use any charcoal, and still we did it for $6.50.

For the Sunol tunnels I would have a compressor that would cost $1500 landed on the ground there. I have made an allowance of $1,000 for getting on the job, and incidentals, and then I allowed $920 extra, housings, foundations, and so on. The $1500 is for the compressor on the cars. I didn't go into the size of the compressor 7015
at all. It will compress enough air for 6 drills. I don't recall how much air each drill takes. Some way or other I have an idea in the back of my head that is about the right size of compressor. I didn't bother about the entire efficiency of that air. You can get a compressor that will compress air sufficient to run 6 Burley Drills for $1500. I have not made any special inquiry, but it is my opinion I could get it. I have never bought a compressor of this size. I bought a little bit of a compressor, and installed it at Buclimo Mine. That was a couple of years ago when they were sinking the shaft. I did not directly buy it. I knew what it cost. We had a compressor installed on a little Tonopah property in Tonopah, Nevada. I don't remember the make, but I think we got that tunnel 7016
equipment from Prescott & Co., in San Francisco. That was about 1905, as near as I can remember. The compressor that we had to sink the shaft was a little bit of one, just big enough to run two pipe drills. It was a very small affair.

I have seen compressors and I have noted them in the equipment for mines, and without knowing it you intuitively acquire a sense of proportion and harmony. You go through a salesroom where mining supplies and compressors are handled, and you say offhand, well that is a 6-drill compressor, here is a 10-drill compressor; you hear the prices, and without being able to tell differently how you have got it, you know that you have a knowledge

that enables you to tell whether you have a thing that is suitable for certain work or not. I have the prices of various compressors, but I did not happen to buy them myself.

7017 I made an allowance of $200 each for the 6 drills. I did not go into the details of the make of the drill; any piston drill—it might be a Leyner Drill; I don't remember whether it is a Leyner Drill or not. A Leyner Drill is one of these devices that you will not create much of a dust while drilling, and I am satisfied that it is a Leyner that I had in mind in making that estimate. I can't exactly describe it to you. I know that the whole thing is that there is water in there, and anyhow that it is a device that you use underground now to prevent making dust. You pipe the water into the hole of the Leyner Drill, according to my impression. I don't know the details of it at all, but I know that I allowed $200 for the Leyner Drill. I don't recall ever having seen a Leyner Drill operated, but I was going to use one from the fact that at the time I was making this estimate my attention was called to the fact that you have to
7018 use devices underground that won't create a dust. I don't know what these machines will weigh.

I have 7,000 feet of 3-inch casing for air, as you have got to work the drill with compressed air. I have 8800 feet of track, and 3750 feet of blower pipe. The office of the blower pipe is for ventilation. If I have 7,000 feet of casing, I assume that I am going to carry my air at least 7,000 feet, and the fact that I only have 3750 feet of blower pipe indicates that I have too much air line here. I don't just remember why I took that much, but that is the figure I have used here. I will tell you, I have probably got too much casing here. I don't think I have too much casing, and I have not
7019 got too much blower pipe. My impression is that I do not think that I estimated that every bit of that work would require a blower. You have adits, or drifts, through which you can get ventilation, and you would not necessarily have to have ventilation at everyone of those faces, as you have got some adits or drifts that you can work from your faces. Until you get through from one end to the other, your adits would not help you. I don't think I figured for air at each face, as I don't think it would be necessary. I don't remember now what enables them at one face to work without air, and not be able to work without air at the other face, but there was a reason why I did not make an allowance for any more pipe than that, but I cannot tell you why that is, as I do not remember. I won't be able to look that up and tell you tomorrow why that is, because I do not see any reference to any notes outside of what I have got here.

7020 I am going to run 1300 or 1400 feet of tunnel with 8 cars. I have made a note in pencil that I ought to have 9, 3 for each face, but I only estimated 8. Those cars have a metal body, and I would

make them with a sort of a board box, but you could get a car holding about a yard made out of metal for about $80. They will last a good long while. You can buy a pretty good car. The general thing that wears out with you on a car is the running gear, and if you protect your axles on the outside so you don't get any dirt or sand in them, your running gear doesn't go out on you.

I haven't got a machine shop with this equipment as such. I have not specifically put in a lathe, but I have charged on this job $14,564. I have not named a lathe, but I have an allowance enough to take care of that, because I have considerable salvage when I get through. My compressor is good. You can get a pretty good lathe
for $400 or $500. I think I have equipment enough here to operate 7021
that. You might run it from a very small motor, but I have charged off 50 cents for equipment, and 50 cents for maintenance and tools, and that would certainly cover it.

Speaking of labor, I have 3 shifts, a man on the compressor, paying him $3.50 a shift. Then I have 2 shifts of the blacksmith and helper; they cost me $6.50 a shift. The 2 shifts will take care of the drills that will be used on 3 shifts. That is all the labor I have. The machinist will be carried in in my maintenance and tools, and he will be the highest paid man on the job. I didn't know exactly how to handle him, and so I grouped him under a charge
per running foot. 7022

I counted on buying repair parts for this work as the work goes ahead, and that is included in this item $14,564. In other words, for equipment at 50 cents a foot; then under the heading of maintenance and tools, that will provide the repair parts. I charge off that only 50 cents a running foot, and for maintenance and tools and upkeep, 50 cents. For $15,000 worth of equipment there will be a recovery of $6500. A compressor will be worth, after it has
run 13,000 feet, 65% of its cost. My recollection is that the Los 7023
Angeles Aqueduct sold some at that price.

Mr. Lippincott: We bought our compressors at a very unusual bargain. We got them for $1600 apiece, and we bought, I think, 14 of them in one bunch, and then when we sold them I think we got in the neighborhood of $1,000 apiece for them. The normal price of these compressors was $400 or $500 apiece more than we paid for them. There are 500 cu. ft. per minute compressors, and it takes about 100 feet of air to the drill.

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